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SUBMAXILLARY GLAND CYST

HOWARD M CLUTE

CYST formation in the submaxillary gland may occur with any obstruction of Wharton s duct   The most frequent cause is a calculus in the duct which prevents, either completely or partially, the discharge of saliva from the gland   Other causes of obstruction of Wharton's duct which have been recorded are foreign bodies, such as a piece of gram, and chronic inflammation arising in the submaxillary gland or in nearby dental structures and affecting the duct   Very rarely a malignant tumor of the jaw or tongue may occlude the duct   Undoubtedly calculus occurs more commonly in the submaxillary gland and its duct than in any other salivary gland and presumably a calculus in Wharton's duct will most frequently be found as the cause of the obstruction

A cyst of the submaxillary gland is commonly called a submaxillary ranula   This may be entirely above the mylohyoid muscle and cause a prominent tumor on the floor of the mouth at one side of and below the tongue   In old cases however, the tumor tends to push down through the mylohyoid muscle and present itself beneath the skin in the submaxillary triangle   In early cases submaxillary ranula may be excised through the mouth, but in later cases external operation with excision of cyst and gland is usually necessary

Although we have had several patients with submaxillary calculi we have not previously seen any evidence of obstruction to the duct sufficient to produce the formation of a cyst   In our

experience patients with submaxillary calculi seek help because of the acute complications which arise These are, first, the "salivary colic" so called, which occurs with a sudden complete obstruction to the duct during the salivation that accompanies a meal. The second common complication of salivary calculus is the occurence of an acute infection in the duct or gland in which it lies. The history of the patient here reported is consistent with

Fig 211 —Part of the submaxillary cyst showing through fascia after the platysma muscle was raised

recurrent obstruction of Wharton's duct by a calculus, with the final formation of a stricture in some one of the ducts of the gland and resultant cyst formation.

Case History.—The patient was a woman aged thirty-four, whose chief complaint was of a swelling in the right submental and submaxillary regions Seven years ago she first noted a soft mass the size of a hickory nut beneath the ramus of the right jaw. This mass grew in size for several days and then discharged into

the mouth. No pain occurred. The tumor repeatedly swelled and discharged into the mouth at intervals for a year. Five years ago the swelling again occurred and extended along the ramus of the jaw—anteriorly to the submental region and posteriorly to the parotid region. This fulness has persisted with little if any variation during the last five years
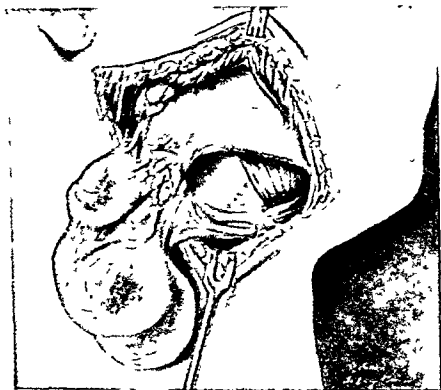
Fig 212—Final stage in the removal of submaxillary gland cyst and the remaining portion of the gland The cyst had extended nearly to the symphysis of the jaw lying largely beneath the ramus. Posteriorly it extended to the floor of the mouth under the angle of the jaw and externally to the region of the parotid gland

On examination a definite diffuse swelling was observed behind and below the angle of the jaw on the right. The swelling was soft and felt cystic. There did not seem to be a tense distention of any sac. By manipulation it was evident that the swelling possessed portions which extended anteriorly beneath the ramus of the jaw to the submental region and superiorly in front of the

ear into the region of the parotid gland With a finger in the
mouth the tumor could be palpated beneath the tongue on the
right side

Operation was performed without particular incident   An
incision was made below and parallel to the ramus of the jaw and
the cyst carefully dissected from contiguous structures   The
wall of the cyst was extremely thin and had extended along the
jaw on the inferior buccal surface to the midline anteriorly
Posteriorly it extended upward into the parotid region   But
very little submaxillary gland tissue was left   All of the outer
wall of the cyst was readily removed with the remains of the sub
maxillary gland   Some of the cyst wall lying deep in the floor of
the mouth was not dissected

Recovery from the operation was uneventful the wound
healing being rapid and complete   No salivary leakage occurred
after operation

Pathologic examination of the specimen showed cystic dilata
tion of a large salivary gland duct which was also involved in
a periductal inflammatory process   Areas of normal salivary
gland tissue were also present

MEDICAL MANAGEMENT OF PATIENTS BEFORE OPERATION FOR HYPERTHYROIDISM

HOWARD M CLUTE AND ROBERT L MASON

THE symptoms of hyperthyroidism can in part be alleviated and the patient rendered a better operative risk by the judicious employment and combination of two methods of treatment one, the use of measures designed to combat the high basal metabolic rate and two the use of iodin the only drug of demonstrated merit which will lower the metabolic rate

Of all the measures designed to combat the high metabolic rate the most generally useful is rest The regular drop of twenty to forty points in metabolic rate that occurs repeatedly if not constantly with rest in bed, can with fairness be laid to a decrease of the metabolic burden from decreased muscular and mental activity To obtain the best results from rest alone particular attention must be given each individual Exophthalmic goiter patients do not adjust themselves readily to rest in bed and they must be personally instructed and persuaded to control their ceaseless wasteful movements and excited conversation Isolation of severely toxic patients and all other indirect aids to rest must often be elaborated to a marked degree Visitors must be limited or carefully selected At times even letters must be withheld because of the depression or excitement they cause

Second only to rest in bed in the preoperative treatment of hyperthyroidism is careful attention to the diet of the patient Thyrotoxic patients almost invariably show striking under nutrition when they present themselves for treatment Their body weight averages 15 to 25 per cent below the normal stand ards The loss of weight may be extreme if the patient has been carrying on an occupation requiring moderate or heavy exertion This marked loss of weight is due to an inability adequately to

meet the high caloric requirement of their increased rate of metabolism The food intake being insufficient, the body tissues are consumed to meet the deficit It has been conservatively estimated that a man with a metabolic rate of +50, doing a moderate amount of muscular work, requires 6000 calories daily to maintain his weight Such a requirement demands an intake of an enormous amount of food, and in spite of the huge appetites nearly all of these patients possess they are unable to consume adequate amounts of food This feature is of great importance in the preparation of the thyrotoxic patient for operation and also during the postoperative period We have found it necessary to furnish from 3000 to 4000 and even 5000 calories daily to prevent weight loss Considerable ingenuity is required on the part of the nurse to furnish a diet which contains the required caloric content, but which is not so bulky as to stuff the patient nor concentrated to such an extent that gastric upsets are induced The patients' favorite foods should be discovered and every effort made to make the food desirable Carbohydrates should be given in plentiful amounts The carbohydrate metabolism in hyperthyroidism has long been a subject of inquiry A few cases show a moderate hypoglycemia during their preoperative preparation and during no immediate postoperative period Others, while showing no hyperglycemia, frequently have glycosuria Excessive oxidation of sugar has been shown to take place in hyperthyroidism From data derived from a consideration of the total respiratory exchange and the respiratory quotient, twice the normal amount of carbohydrate has been shown to be oxidized in a given period in hyperthyroidism Animal experiments have shown a depletion of glycogen in the liver in cases of induced hyperthyroidism Since glucose is oxidized at a rate greater than normal in these patients and there are indications that there is a depletion of the carbohydrate reserve the necessity of carbohydrate is clear

Thyrotoxic patients frequently show evidences of marked dehydration when they present themselves for treatment Many are mildly acidotic The heat generated by the increased energy exchange within the body must be removed by evaporation, and

for this purpose an increased supply of water is essential if dehydration is to be prevented   In our experience, fluids should be forced to an intake of at least 3000 c c daily   The fluid intake need not, of course, be confined to water   Ginger ale, grape juice, etc   are doubly useful in that carbohydrates are also furnished   Tea and coffee we avoid because of their stimulating action

In patients with intense toxicity, whose weight loss has been excessive, gastro intestinal crises manifested by vomiting and diarrhea frequently occur   These patients are dehydrated, and it is obvious that considerable tissue breakdown has occurred to meet the demands of their high metabolism   Acidosis may be present or impending   The indication here for fluids and glucose is imperative and the improvement following the intravenous administration of 500 c c of a 10 per cent glucose solution is usually marked

The glucose should be given in a 10 per cent solution and the flow so arranged that at least an hour's time is consumed in the introduction of 500 c c   If introduced at a more rapid rate a considerable portion of the glucose is apt to be excreted in the urine   Blood sugar determinations taken two hours after such an administration of glucose show but a slight degree of hyperglycemia   If the patient has, during previous observation, shown glycosuria, the blood sugar level following intravenous glucose is often sufficiently high to produce a marked glycosuria   In these patients small doses of insulin may be used to advantage in accelerating the utilization of the sugar   We do not recommend the routine use of insulin in conjunction with the glucose since in hyperthyroidism no deficiency in carbohydrate utilization exists, and if the glucose is given at a sufficiently slow rate most of the sugar is utilized satisfactorily   Theoretically, the use of insulin is contraindicated in hyperthyroidism   Insulin in the non diabetic has been shown to reduce the glycogen content of the liver   As before stated, the glycogen content in hyperthyroidism is at a low level, and further depletion by insulin would appear unwise

We have given iodin in thyroid storms in large doses directly and parietally according to circumstances   We believe it is often

meet the high caloric requirement of their increased rate of metabolism   The food intake being insufficient the body tissues are consumed to meet the deficit   It has been conservatively estimated that a man with a metabolic rate of +50 doing a moderate amount of muscular work requires 6000 calories daily to maintain his weight   Such a requirement demands an intake of an enormous amount of food and in spite of the huge appetites nearly all of these patients possess they are unable to consume adequate amounts of food   This feature is of great importance in the preparation of the thyrotoxic patient for operation and also during the postoperative period   We have found it necessary to furnish from 3000 to 4000 and even 5000 calories daily to prevent weight loss   Considerable ingenuity is required on the part of the nurse to furnish a diet which contains the required caloric content but which is not so bulky as to stuff the patient nor concentrated to such an extent that gastric upsets are induced   The patients favorite foods should be discovered and every effort made to make the food desirable   Carbohydrates should be given in plentiful amounts   The carbohydrate metabolism in hyperthyroidism has long been a subject of inquiry   A few cases show a moderate hypoglycemia during their preoperative preparation and during the immediate postoperative period   Others while showing no hyperglycemia frequently have glycosuria   Excessive oxidation of sugar has been shown to take place in hyperthyroidism   From data derived from a consideration of the total respiratory exchange and the respiratory quotient twice the normal amount of carbohydrate has been shown to be oxidized in a given period in hyperthyroidism   Animal experiments have shown a depletion of glycogen in the liver in cases of induced hyperthyroidism   Since glucose is oxidized at a rate greater than normal in these patients and there are indications that there is a *depletion of the carbohydrate reserve the necessity of carbohydrate is clear*

Thyrotoxic patients frequently show evidences of marked dehydration when they present themselves for treatment   Many are mildly acidotic   The heat generated by the increased energy exchange within the body must be removed by evaporation and

case of exophthalmic goiter and we have usually been surprised to find adenomata present in addition to simple hyperplasia. In regard to them we feel that clinically they cannot be separated from true cases of exophthalmic goiter and that they should be classed in that group in a discussion of this sort.

The actual method by which the patient with primary hyperthyroidism obtains iodin is of secondary importance. We commonly give compound solution of iodin in 10-minim doses diluted in water three times a day after meals. If this method is inadvisable, the iodin may be given in 5-minim doses by mouth at shorter intervals or by rectum well diluted in water. In emergencies we have given it intravenously and subcpectually in doses of 50 minims of Lugol's solution to 1000 c.c. of normal saline. We have seen no disturbance from this in the few cases in which we have felt compelled to give the drug in this manner. When a thyroid storm is anticipated we force iodin by every available route in large doses up to 100 minims of Lugol's solution in twenty-four hours, and we continue giving large doses for one or two days after the storm has passed.

Dr. R. B. Cattell, in this clinic, has studied the microscopic changes produced in the hyperplastic thyroid gland by iodin feeding, and he has found these to be both typical and pronounced. In hyperplasia the papillary projections into the acini of the gland with their highly active columnar epithelium are replaced or markedly altered. The acini become distended with colloid material and the epithelium is made up of cells much lower and apparently less active. It has long been known that the iodin content of the thyroid gland diminished in direct proportion to the degree of hyperplasia present. What the reason for this extraordinary change in the structure of the gland after iodin therapy may be is not known. It occurred, however, in 88 per cent. of the cases of true hyperplasia that were given iodin.

The improvement in clinical symptoms and in basal metabolic rate in cases with thyroid gland hyperplasia receiving iodin is generally very marked. The average drop in basal rate after eight days of rest in bed and iodin feeding is thirty points

Apparently the maximum iodin effect is obtained within eight to twelve days of its first administration This then is the optimum time for operation From 7 to 10 per cent of our cases, however fail to show any marked improvement of basal rate These cases may nevertheless show a marked improvement of their nervous symptoms in spite of this fact We have found as Plummer has said that in most cases the nervous symptoms of exophthalmic goiter are particularly affected by iodin The tremor is less the exophthalmos diminishes and the subjective feeling of nervousness disappears In a few cases all the symptoms and signs of the disease have completely disappeared It is our firm belief however that iodin alone will not cure exophthalmic goiter We are constantly seeing patients who have been carried along on iodin therapy for months and even years in the hope that the disease would be permanently checked In no case that we have seen has this occurred Toxicity has not been obtained until a part of the thyroid gland has been removed Furthermore when iodin administration is carried far beyond the early period of maximum effect its great value in reducing the operative risk is lost

Not only is the use of iodin alone insufficient to produce a cure in cases of exophthalmic goiter but also is it frequently misleading in the degree of apparent improvement that it has brought about In our early experience we were misled in certain cases by the marked drop in basal rate and the great clinical change into doing a larger operation than the true condition of the patient warranted We now believe that a patient who is dangerously ill on admission to the hospital does not become a good surgical risk in a few days no matter how much iodin he may receive or how great the apparent improvement Potentially he is still a serious operative risk and must be so considered

The use of iodin has certain very definite limitations in our experience We have had patients enter a thyroid storm after several weeks of constant iodin medication and go on to death in spite of large amounts of iodin fluids rest and morphin and in the absence of any operative procedure Postoperative storms have occurred in patients thoroughly prepared for opera

tion with iodin. However, while there are certain very definite limitations to the results iodin will produce in the treatment of exophthalmic goiter, it is nevertheless the greatest single agent that we possess for preparing these patients for surgery. It is very important that its effects be cautiously accepted and carefully interpreted in the light of the recent history and findings in each case.

While diabetes is not a common complication of hyperthyroidism, the rather frequent occurrence of glycosuria renders the accurate decision as to the presence or absence of this condition of extreme importance. During the year 1925, of the 700 patients operated for thyroid disease in the Lahey Clinic, 17 had a glycosuria of sufficient significance to be classified; of these 13 were true diabetics, 3 were potential diabetics, and 1 was a renal glycosuric. These cases have been carefully followed by the diabetic service of Dr. E. P. Joslin, and those which have proved to be true diabetics have been treated with insulin. Since operation 3 have discontinued their insulin and 2 have been able to reduce the dose. In none has there been a progressively downward tendency after operation, but, on the contrary, the majority have shown a greater increase in tolerance than the average diabetic. In Dr Joslin's opinion the prognosis of the thyroid diabetic must be guarded. Every thyroid patient with glycosuria should be considered a potential diabetic for life, even though symptoms have been alleviated by partial removal of the gland. There is no marked increase in the risk of thyroid operations upon diabetics who have been prepared with insulin and proper diet provided they have not recently been in coma When this complication has occurred shortly before operation the patient's ability to withstand surgery is materially reduced.

Hamilton has already reported the effect of thyroid toxicity on the heart based on a personal study of this problem in this clinic for the last six years. Thyroid toxicity drives hearts. The heart rates alone show this by commonly rising to extraordinary heights under ordinary stress. Rheumatic infections and heart diseases are proportionately high among thyroid patients, and some young hearts will fail because of these com-

plicating conditions Patients with young sound hearts, how ever tolerate this thyroid drive Even though driven to death by the intoxication they do not die a true cardiac death Many of the older or coincidentally damaged hearts however, are driven into auricular fibrillation This is almost never found among thyrotoxic patients under twenty years of age, and only an occasional case between twenty and thirty years will have it no matter how severe or prolonged the toxicity But in each older decade the percentage increases until more than 85 per cent of the thyrotoxic patients who are over sixty years of age have auricular fibrillation Altogether about 35 per cent of the definitely toxic patients in our clinic have auricular fibrillation at some time during observation Under no common strain or disease does such a high percentage of cases develop this disorder

Thyrotoxic patients with auricular fibrillation deserve special care It is in these cases and in these cases only, that we have found appreciable benefit from thorough digitalization Many details of rest and care to remove all unnecessary burden on the already dangerously burdened heart must be enforced This group is particularly fragile An occasional individual will die suddenly and unexpectedly without cause to be found at autopsy, an occasional case may have an embolus from an intracardiac thrombus The most common danger is from the development of true *congestive heart failure* A large portion of the patients with transient attacks of auricular fibrillation and a larger portion of those with established auricular fibrillation, have congestive heart failure shown by swollen livers orthopnea râles cough and often a general edema This group is distinct from the group presenting the picture of the thyroid storm without congestive heart failure previously described

Hamilton finds that the important aspects of medical treatment of the heart in thyrotoxic states are *First* the search for an obscure underlying thyroid toxicity in certain cardiac conditions

Second the realization that while medical treatment can improve the heart condition temporarily in the majority of cases, it fails to give permanent results In particular one wastes

time and increases risk by prolonged medical care with digitalis quinidin, rest etc , in an attempt to relieve paroxysms of auricular fibrillation due to thyroid toxicity   When cases with established auricular fibrillation and even with congestive heart failure are properly prepared they can be tided through a thyroid operation with a mortality of less than 3 per cent   Proper removal of the thyroid gland results in a permanent cure of the pure thyroid heart

Satisfactory results in the treatment of hyperthyroidism must be based upon an accurate diagnosis of thyroid toxicity intensive study of the individual case, rational preoperative management carefully organized surgery, and personal care following operation   Surgery is the only procedure of demonstrated merit for the cure of hyperthyroidism   Its so called failures are due to inaccurate diagnosis or inadequate operation

REMOVAL OF THE CERVIX IN HYSTERECTOMY FOR BENIGN LESIONS

Frank H. Lahey

In the July, 1923 number of the Annals of Surgery we published a description of a method of removing the major portion of the cervix in hysterectomy for benign diseases by transcervical excision, without danger to the uterus, without shortening the vagina, and without adding to the time necessary for the usual supracervical hysterectomy.

We have now performed this operation on 86 patients, with marked satisfaction. It has practically all the advantages of a complete hysterectomy in that the greater part of the cervix is removed, with none of the disadvantages.

After the uterine appendages have been tied off and cut, and the uterine arteries on either side of the cervix clamped with Ochsner clamps and cut, the uterus remains attached only by the cervix. An incision is made in the anterior surface of the cervix and grasped with double hooks and a similar one made in the posterior surface and likewise grasped with double hooks. This incision is made only to a depth of about ¼ inch, and completely encircles the cervix. By traction on the uterus and by continuation of the incision downward—remaining always only about ¼ inch from the outer wall of the cervix—that structure is gradually pulled upward and dissected from its shell just as the finger of a tight glove is everted by the extraction of the finger from it. The whole cervix is finally extracted, a gauze strip pushed through the shell of the cervix into the vagina, and the stumps of the broad and round ligaments sutured into the cavity left by the removal of the cervix.

There is often considerable oozing, which may be readily controlled by a mattress-suture passed from behind forward and back again, to be tied on the back of the cervical shell.

It has been necessary a few times to suture the lower end of
the cervical shell through the vagina because of unusual oozing
This has, however, always controlled bleeding, as there have been
no cases in which any serious oozing has taken place
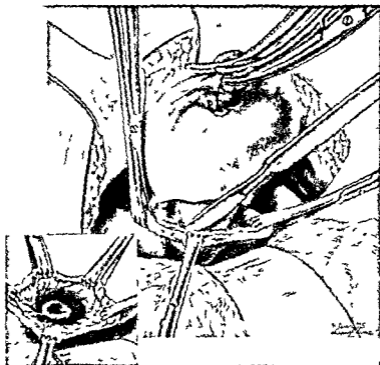
Fig 213 —Showing method of excising cervix and leaving behind a
thin shell of its wall   Insert shows the shell and pocket with the vaginal
opening at its bottom

The disadvantages of this procedure have been the increased
oozing and the occasional necessity of suture of the cervical shell
from below

The advantages are that practically all of the cervix may be
removed together with the fibroid or uterine fundus without
shortening the vagina lessening the danger of malignancy in the
cervical stump, and the cervical canal with its frequently per-
sisting endocervicitis is removed, a cavity remaining in the

cervical shell into which the structures holding up the vagina and
bladder may be deeply implanted so that good suspension is

Fig 214 —Uterus with the excised cervix

Fig 215 —The same uterus as shown in Fig 214 with the cervix split to show
completeness of removal

obtained   The operation may be done without added danger to
the uterus with only two or three minutes' time added to the
operation.

THE EFFECT OF IODIN ON THE PATHOLOGY OF EXOPHTHALMIC GOITER

Richard B. Cattell

SURGEONS have long recognized the occurrence of atypical glands in exophthalmic goiter. There have been many reports of so-called colloid glands found in patients suffering from severe Graves' disease. Such observations are by no means limited to the earlier thyroid surgeons, several instances occurring even in the current year. An attempt to explain such findings, both by surgeons and pathologists, has led to much confusion in understanding the pathology of this condition. The pathologist has been prone to call glands with slight hyperplastic changes as beginning or mild exophthalmic goiter, while in the case of colloid glands in this condition both the pathologist and surgeon have in many instances joined in believing that there was a mistake in diagnosis

With the reintroduction of the use of iodin and its wide general use, these discrepancies become explained. In the four years that iodin has been extensively used, there have been sufficient clinical and metabolic reports to show a fairly uniform result of iodin feeding, yet the changes in the gland have been rarely reported. Early in its use in this clinic we were impressed at the time of operation by the appearance of the glands which had had a preoperative course of iodin therapy in contrast to those receiving none. The ease of operability due to the decreased vascularity and the slight postoperative reaction were impressive; in addition, the glands were extremely friable due to the increased colloid content, making it difficult to grasp the gland with instruments for the purpose of displacing it. These differences led us to make a comparative study of a series of glands with and without iodin, as well as a controlled series of

the changes *both chemical and pathological* in the gland of the
same patient before and after iodin   (This was done by multiple
stage procedures)   These findings we have reported in detail
elsewhere [1]

Before the use of iodin a fairly constant pathologic picture
was associated with exophthalmic goiter   This goiter is of
a symmetric bilateral and uniform nature   The palpated
gland feels soft and compressible due to the large volume of
blood in the enlarged vessels   This is in contradistinction to the
gland after removal when it is firm due to the collapse of the
vessels with the loss of the engorged blood   The gland is regular
in outline or marked by coarse lobulations   The surrounding
connective tissue is not thickened   On section it is grayish pink
or reddish brown in color   has a meat like surface with fine
lobulations and a very granular appearance   The acini can
rarely be made out with the unaided eye or   if visible are greatly
decreased in number   This same gland microscopically shows
an almost solid cellular structure   The epithelium is high
columnar with vesicular nuclei near the attached border and there
is a pale finely granular cytoplasm   The mitochondria by
appropriate stain are greatly increased in number   The acinar
spaces are encroached upon by the uneven overgrowth of the
epithelium so as to produce papillary projections   The colloid
content is greatly diminished or absent   when present is unevenly
distributed   The connective tissue elements of the stroma are
increased   The blood vessels are enlarged   especially on the
surface and many capillaries are found throughout   Infiltration
with round cells is common   beginning diffusely   later forming
true lymphoid follicles   This is more marked in severe long
standing cases   with replacement of the epithelial elements at
times giving the anatomic appearance of myxedema

In contrast to this well recognized usual picture after suf
ficient iodin feeding   changes take place in a reverse direction

[1] Cattell R. B   The Pathology of Exophthalmic Goiter After Iodin
Administration (Chemical and Histological) Boston Med and Surg Jour
1925 192 989   The Relation of Iodin to Certain Pathological States in the
Human Thyroid with Especial Reference to Exophthalmic Goiter   (In
press) Proc New York Path Soc 1925 25 No 628

i e, a return toward the normal appearance (involution)   The gland becomes firm and usually decreased in size, although at times it is said to be increased   After removal this gland feels definitely softer than the hyperplastic one, due to the deposition of the semifluid colloid   It has the same regularity, but is yellowish brown in color   The cut surface is moist, with few trabeculæ   Numerous acini can easily be made out and a viscid fluid may be forced out by hard pressure   If a thin section 1 to 2 mm thick be cut from this gland, it will be found to transmit light and show only a fine supporting framework   Such sections from a patient undergoing two hemithyroidectomies six to eight weeks apart, with iodin during the interval, show a marked contrast (Fig 216)   The one before fails to transmit light, presents no acini, and does not reveal its structure, the other, after iodin, is clearer, due to the large amount of colloid and small cellular elements

Microscopically, sections from a completely involuted gland show acini slightly larger than normal, filled with a deep staining colloid   The epithelium is low cuboidal or flat, with a small amount of cytoplasm and small dark nuclei   The acini are more regular in outline with only few residual papillary projections   Numerous lymphoid follicles and diffuse round cell infiltration remain   The blood vessels are inconspicuous and show thickened walls, tending to obliterate them   The stroma is nearly normal, yet has a few fibrous scars   This apparent great change in the stroma suggests autolytic changes and shrinkage, as well as to indicate that the solid appearance of the hyperplastic gland is mainly due to epithelial proliferation   Several photomicrographs illustrating these changes, in a controlled series will be found in our previous papers   Reinhoff, in a controlled study of 3 cases, found similar changes, in a more general way others have recently noticed this anatomic effect of iodin   In reviewing the sections from the glands removed before the introduction of iodin, an occasional instance of a colloid type of gland and in several instances a slight hyperplasia were found in our series, yet many of these had presented a severe clinical picture   These we now believe had received iodin in some form

The hyperplastic glands have a consistently low iodin value, ranging from 1/10 to ½ (0 3–1 gm) of normal. (The normal value should be considered as 2 mg per gram of dried gland) The iodin content of the glands following iodin administration
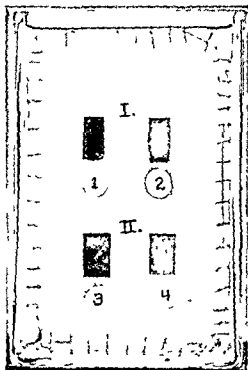
Fig 216—Photograph of transilluminated sections from the thyroid before and after iodin one half natural size Patient I Section 1, gland at first hemithyrodectomy No iodin Very hyperplastic Iodin content 0 28 mg B M 48 Section 2, second operation, eight weeks later, with small amounts of iodin Moderate involution Iodin content 1 5 mg B M 40 Patient II Section 3, iodin eight days before operation Early involution Iodin content 1 3 mg B M 69 Section 4, second operation eight weeks later with iodin Marked involution Iodin content 7 9 mg B. M 35

was increased in every instance The involuted glands have a consistently high value, in one instance four times normal (8 4 mg) The large range of iodin values for involuted glands is confusing unless the microscopic appearance is considered.

After estimating the degree of involution, we found that the iodin values bear a close relation. In all glands in which there was over 3 mg. the involutional changes were marked, but varied greatly. Below this figure the iodin value and the degree of involution varied directly; in these glands the iodin could be
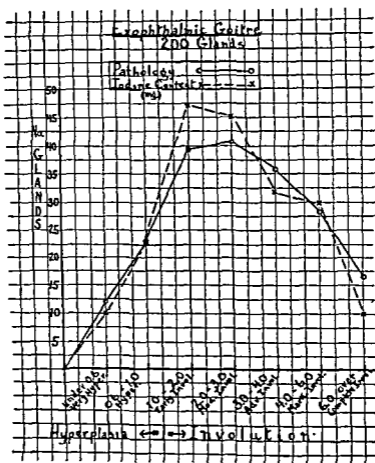
Fig 217.—The relation of iodin content to the pathology. Iodin values and pathologic structure are plotted on the abscissa. The incidence of each plotted on the ordinates.

roughly estimated from the section. It is to be expected, however, that much of the iodin stored was not in the form of "thyroid iodin" since feeding was continued up to the time of operation.

The accompanying graph (Fig. 217) illustrates the close relation between the iodin value and the histologic structure,

MANAGEMENT OF TOXIC GOITER

FRANK H. LAHEY

THE views regarding the management of cases of primary hyperthyroidism as expressed in The Surgical Clinics of North America, December, 1925, have been so materially modified by the introduction of iodin that our present plan of management of toxic cases is here presented

The necessity for care and critical study of cases of suspected hyperthyroidism still obtains   In fact as we have repeatedly stated in the past year, the use of iodin has been so enthusiastically accepted by the medical profession that any patient who has goiter, thinks she has goiter, or may have goiter has had what used to be called a course of iodin   As we have often, in our writings on this subject stated the determination in obviously neurotic individuals as to whether or not an already existing neurotic or psychiatric condition is complicated by a coexisting thyroidism may tax the resources of the most skilled and expe rienced thyroid observer   Where the patient has been taking Lugol's solution over a considerable period of time before coming for observation it becomes an even more difficult and confusing situation   Under such conditions we have not infrequently sent such patients home to be off iodin treatment for one month and to then return for observation and basal metabolic studies

The management of patients with primary hyperthyroidism or exophthalmic goiter today in the clinic consists of preoperative rest and Lugol's solution until it is evident that the most marked degree of gain has been made, as evidenced by improvement in symptoms and drop in basal metabolic rate   A large number of those cases have shown this improvement in from eight to twelve days, although there is no fixed period of time which is allowed for this preoperative rest and medication, 92 8 per cent have

shown a definite drop in basal metabolic rate, 7 2 per cent have shown no drop or have shown an increase in basal metabolic rate

This preoperative rest and preparation with iodin has resulted in the past year in a markedly diminished number of multiple stage operations During the year 1925 754 thyroid operations were performed upon 680 patients 290 of whom suffered from primary hyperthyroidism or exophthalmic goiter, 138 secondary hyperthyroidism or toxic adenomata, and the remainder non toxic adenomata cysts, multiple colloid adenomata and malig nancy All of the multiple stage procedures were related solely to the toxic goiters There was one preliminary pole ligation and 53 patients were operated upon by two stages—a right and left subtotal hemithyroidectomy

When one recalls that previous to the employment of iodin but 38 per cent of our cases were operated in one stage it is evident that the preoperative preparation of patients by rest and iodin has very remarkably modified the plan of procedure There were 8 deaths among all cases operated upon for thyroid disease last year 1 from typhoid hemorrhages—admitted directly from another hospital with severe thyroidism without symptoms of typhoid, operated for goiter, recovering from the subtotal thyroidectomy with development of typhoid and positive blood and Widal death thirty days after operation One from embolus The mortality rate being in primary hyperthyroidism 2 06 per cent , secondary hyperthyroidism 1 38 per cent , and non toxic goiters 0 per cent , estimated upon a patient basis

There are certain factors regarding the preparation of patients with primary hyperthyroidism by the use of iodin which from our experience should be particularly emphasized to the medical public Iodin is of great value in saving those individuals who are suffering from the severest form of thyroid intoxication as evidenced by delirium, vomiting diarrhea, and excessive excita tion This is a state that usually results from the medical attendant's procrastination and is a direct reflection upon his judgment and policy if it occurs, since almost none of these cases reach this alarming state without previously having had the

disease for some time in a more mild and practically safe operative stage

The use of iodin however, as a method of treatment of primary hyperthyroidism with the aim of cure, from our experience, is not a logical one   We have repeatedly administered iodin to patients upon whom we had previously operated for primary hyperthyroidism and removed insufficient thyroid tissue, resulting in a persisting thyroidism   In none of these cases have we been able to cure this persisting thyroidism with iodin and all have required further operation and removal of thyroid tissue to bring about a cure

From our point of view it would be ideal if we could receive the patients with primary hyperthyroidism those with hyperplastic thyroids before they had received any iodin a condition which we almost never see now, so universally is iodin administered to goiters of all types   Iodin as a preoperative medication when effectual appears to accomplish its greatest good within a period of approximately two weeks   Following this there is a period when there is no further improvement, and beyond this a period when a great many of the cases lose a good part of the improvement which they have shown under the administration of iodin   When the patients come to the clinic after having had iodin for considerable periods of time it is doubtful if the same degree of preoperative improvement is accomplished with this drug

Another advantage of receiving the patient for operation free from iodin treatment is, first, that those who are to handle the operative cure of the toxic thyroid patient are able to observe and be impressed with the degree of toxicity which the patient presents before iodin is administered, and second that they may recognize and obtain the full extent of gain from this method of preparation

These factors, in our experience, are extremely important since we have seen many patients with severe hyperthyroidism who under iodin and rest were made quite calm persons, with lowered pulse rates and lowered basal metabolic rates, apparently good operative risks, and yet capable as we have had demon

strated to us to our sorrow of showing serious and even fatal
postoperative reactions entirely out of proportion to their
apparent preoperative state of operability   We have urged
therefore that complete operations be undertaken upon toxic
goiter patients only after a consideration of what their state was
previous to the administration of iodin when they were at their
worst and that limited procedures such as hemithyroidectomy,
be undertaken if the slightest doubt exists as to their ability to
stand the entire procedure   We still feel that pole ligation, while
rarely necessary has a place in those patients coming to the
clinic for operation in the severe stages of hyperthyroidism   We
have lost 3 patients with severe hyperthyroidism following first
stage hemithyroidectomy   and we have never had this happen
without the feeling that had we undertaken a lesser procedure
such as pole ligation the fatality might not have occurred

It must distinctly be admitted that the intensely toxic thyroid
patient is a dangerous risk often capable of unsuspected possi
bilities in the way of serious postoperative states   With this
admitted and only the inexperienced would deny it very little
stress can be placed upon the advantage of a single stage opera
tion   We feel that this statement bears additional weight in this
clinic when we say that we have never had a patient with severe
hyperthyroidism die following the second stage hemithyroidec
tomy   If they have been able to endure the first stage hemi
thyroidectomy they have been able to endure the second either
because they were no worse or very decidedly better   We have
seen no patients show intensification of toxicity between the
two stages of first and second hemithyroidectomy   Were we
able to operate 50 patients with intense hyperthyroidism or
100 or even more in one stage and should one die we would
consider that we had used poor judgment upon the remainder
since the death of one under the same conditions of judgment
means that many more of the remainder were capable of the same
unappreciated degree of fatal reaction   Never in our opinion
should the matter of the patient s wish or convenience be per
mitted (they tend to markedly) to sway one s judgment in the
slightest degree toward a single stage procedure

So much has been written and said regarding the elimination of multiple stage procedures by the use of iodin that the value of the divided operation upon these frail risks tends to be diminished and lost sight of   One or two possibly added steps leave one only with the possible regret of overcautiousness, not to be compared with the regret and responsibility which attends the lack of this attribute in relation to the surgery of intensely toxic thyroid patients   When, in addition to this we assess the mortality of each course and find that the conservative plan has a mortality rate in this clinic which is small compared with the more daring plan   then for us there is no question as to the choice of plans in the doubtful case

As a final word regarding the use of iodin in toxic goiters, we have previously urged that there are few surgical conditions in which mortality rates are so dependent upon estimation of operability and the extent of operability as in toxic thyroid states   This judgment may be acquired in our estimation only by a prolonged and constant contact with patients suffering from these states of thyroid intoxication and their reaction to surgical procedures   It is not a situation that permits of laying down a set of rules by which one may be guided solely   It requires that each case be weighed and debated individually, and that every markedly toxic thyroid be submitted to surgical procedures with the possibility of a fatality in mind, and weighing heavily in selection of the course and plan of the surgical procedure employed

The above remarks are made not only for what value they may have to those relatively inexperienced with toxic thyroid states, but also that we may urge that any change from a multiple stage plan of dealing with these patients untreated with iodin should be made with the utmost caution and only after a considerable experience with operations upon patients who have been on iodin treatment   If we tend to repeat this warning it is only because we know that the transition from operating upon toxic thyroid untreated with iodin to operating upon those treated with iodin has doubtless resulted in many fatalities that might have been avoided had less dependence been placed

upon the occasional false security obtained by preliminary iodin feeding and more trust exhibited in the continuation of cautious operative approach

The patients are still given preliminary drugging with scopolamin and morphin—scopolamin now but one dose of 1/200 and two doses of morphin gr $\frac{1}{6}$ to $\frac{1}{4}$ two hours and one hour previous to operation   Doubtful cases have but one side of the gland exposed for removal so that should the course of the operation indicate an unfavorable reaction on the part of the patient the neck may be closed and the remaining lobe removed six weeks later

As was the original plan in any case in which doubt exists as to a severe reaction a lesser stage than was originally contemplated is done

In conclusion we wish to urge strongly that multiple stage procedures be still employed where the slightest doubt exists as to the outcome of the operative treatment and that every toxic death following an operation for toxic goiter be frankly admitted as due to poor surgical judgment should it occur when a lesser surgical procedure could have been employed

ESOPHAGEAL CASES

D. Crosby Greene

DURING the years 1924 and 1925 a series of 30 esophageal cases have been treated at the New England Deaconess Hospital These are divided into the following groups

Carcinoma	11
Stricture	8
Foreign body	6
Diverticulum	3
Card ospasm	2
Total	30

The esophagoscope was used in all cases to establish the diagnosis and in most instances to carry out the treatment

CARCINOMA

The 11 cases in this group were all in an advanced stage of the disease and the treatment was entirely palliative   Gastrostomy and radiotherapy were advised, but in only 4 cases was consent for operation given   In these 4 cases there was an undoubted prolongation of life for three or four months as shown in the following illustrative case

Mr G D B , aged sixty three years, consulted us on February 27, 1924, complaining of increasing difficulty in swallowing during the past three months with recent considerable pain x Rays (Fig 218) showed obstruction to the passage of barium mixture at the level of the sternal notch and the irregularity of constriction characteristic of malignant disease   On March 4th esophagoscopy was done under ether anesthesia   An obstructing growth was encountered at 20 cm from the incisor teeth, a hard, irregular, ulcerating tumor, the upper portion of which projected like a lip into the lumen from the anterior wall   A specimen was removed for biopsy, and a bougie, No 26 French, was

passed with slight resistance through the stricture Five seeds of radium emanations each 1 mc were inserted into the growth at different parts Following this treatment the patient suffered considerable pain and was able to swallow hardly at all for three days during which time fluids given by rectum Gastrostomy was then performed on March 7th From that time until his death four months later he subsisted entirely on nour

Fig 218—Roentgenogram Carcinoma of the upper third of the esophagus showing irregularity of constriction character stic of mal gnant d s ase

ishment taken through the gastrostomy tube For two months he gained in weight and strength and was able to attend to his business affairs Then gradually failed until his death two months later

Comment—The improvement in the patient s general condition after gastrostomy was marked and has in our experience been characteristic of the cases in which the operation was done fairly early and not as a last resort

STRICTURE

The 8 cases in this group included 1 case of lye stricture, 5 cases of webs or bands at the upper or lower extremity of the esophagus, 1 case of multiple stricture of unknown origin, and 1 case of probably congenital stricture of the lower end of the esophagus

All these cases were with one exception treated successfully by esophagoscopy with dilatation by bouginage   The exception was a case where an adhesion just behind the cricoid cartilage, with anterior and posterior attachments divided the esophagus into two channels   The excision of this band by punch forceps resulted in complete relief of marked symptoms of obstruction with inability to swallow anything but liquids

A stricture of moderate degree may result in complete obstruction by the impaction of a mass of unmasticated food at the point of narrowing, as shown in the following case

Mrs J A R, aged forty five years consulted us on December 6 1924, consulted us on account of difficulty in swallowing which had troubled her for about five months and was gradually increasing Food would go down, but shortly be regurgitated   At the time of her first visit she was regurgitating almost everything that she swallowed, including liquids   She was very weak and emaciated, having lost 40 pounds in five months   She stated that she remembered having had in previous years similar attacks when she regurgitated food but these had been of a few days' duration and had not interfered with her health x Rays showed a moderate dilatation of the whole esophagus, and a constriction at the lower end at the level of the diaphragm (Fig 219) On December 8 1924 esophagoscopy was done under ether anesthesia   The esophagus was found moderately dilated, but no other marked abnormality was noted until at the lower end, about 35 cm from the incisor teeth a mass of foreign material was encountered, which on removal proved to be decomposing chicken meat   The lumen was constricted to about 1 cm at a point just below the lodgment of the foreign body, but this was readily dilated with bougies up to size No 46 French   Recovery was uneventful

This patient has returned for observation and bouginage at gradually increasing intervals from two weeks to three months She has regained her lost weight and experienced no further serious obstruction to swallowing

Comment --The stricture in this case was probably congenital and of a moderate degree   It manifested itself only after

Fig 219 --Stricture of the lower end of the esophagus   Moderate dilatation of the whole esophagus above the stricture

the ingestion of a large bolus of food which became impacted at the stenosed region   Owing to the readily dilatable nature of the stricture and the dilatation of the esophagus above it this case might be considered as one of cardiospasm, but it seemed to us that the stricture was organic probably congenital in origin, and should be so classified

FOREIGN BODY

Foreign bodies recovered from the esophagus were a safety-pin, a piece of wire, a fishbone, a lobster shell a piece of meat, a ring, and a nickel, the last two were both impacted in the same case above a stricture of the middle third of the esophagus In 2 cases the foreign body was not recovered In the first a piece of meat which almost completely obstructed the esophagus was dislodged spontaneously before it could be found In the second case a safety pin was found, but attempts at extraction failed

Robert V, a seven month old infant, was brought into the hospital on June 19, 1925, having swallowed a small safety pin six days previously The child had taken its nourishment regularly but appeared fussy and cried a good deal There was no fever x Rays showed the pin in the esophagus just below the level of the sternal notch, the point up and turned to the left Esophagoscopy was done, under light ether anesthesia and the shield of the pin located, but in the course of the manipulation for extraction the pin slipped from the forceps and was pushed down into the stomach The course of the pin was then followed by x rays In two days it had apparently left the stomach and remained in about the same position below the stomach and a little to the right of the median line for about five weeks (Fig 220) Although the child was in good condition and showing no harmful effects, it was then decided to have a laparotomy done However, x rays taken the day before that set for operation showed no pin It was never recovered and must have been lost in the stools The x ray picture taken on the thirty first day is here shown An attempt to localize the pin by the injection of barium mixture through a rectal tube into the sigmoid resulted in a distortion of the sigmoid without showing its relation to the pin The stomach appears distended with gas and the pin lies clearly below the stomach

Comment —Safety pins in the esophagus which become dislodged and pass into the stomach usually pass through the gastro intestinal tract without harm in a few days These cases should be closely followed by x ray and careful physical ex-

amination with a view to laparotomy if any evidence of fixation or perforation appears This case is remarkable on account of the unusually long sojourn of the pin in the intestinal tract without complications

Another case not included in the series was that of a foreign body, a fragment of steel, embedded in the party wall between

Fig 220 —Safety pin in intestinal tract of eleven month-old infant thirty-one days after ingestion The pin was discharged spontaneously a few days later

the larynx and trachea just above the cricoid This was an industrial accident case The fragment of steel was a portion of a steel cylinder which had exploded from the excessive high pressure of a gas which it contained The piece of metal was driven into the left side of the neck, passed through the larynx, and became embedded in the middle of the posterior wall of the

larynx. When admitted to the hospital on September 3, 1924
he was moderately dyspneic. Laryngoscopic examination showed
congestion and swelling of the mucous membrane and marked
limitation of movement of the cords, but no indication of the
location of the foreign body. x-Rays showed the position clearly
(Fig. 221). On account of dyspnea tracheotomy was done on
September 8, 1924. On September 18th examination with the
direct laryngoscope failed to locate the foreign body. It was

Fig 221 —Fragment of steel embedded in the posterior wall of the larynx
The foreign body was removed by median thyrotomy.

evident that it was completely buried in the tissues at the back
of the larynx, and it was decided that the search should be
attempted by external operation. Two methods of approach
were tried: the first, by a lateral incision, proved to give inade-
quate access to the region involved; the second approach, through
a median incision splitting the thyroid cartilage longitudinally,
provided an easy access to the posterior wall where the foreign
body was readily located and dissected out.

DIVERTICULUM

Three cases of diverticulum were examined esophagoscop ically Two of these were cured by subsequent external opera tion

Mrs E A B , aged seventy five years was first seen by us on March 28 1924 when she was brought to the hospital as an emergency case with complete obstruction of the esophagus, having been unable to swallow water for two days She said that for many years she had been obliged to chew her food thor

F g 222 —Puls on diverticulum of esophagus

oughly in order to swallow it but had had no serious difficulty until four days previously when eating meat she experienced discomfort and marked difficulty in swallowing which increased so that she was unable to take even liquids x Rays taken on admission (Fig 222) showed a large diverticulum of the upper end of the esophagus at the usual site Esophagoscopy was immediately done under ether anesthesia The scope was readily passed into the sac and the normal opening discovered by the aid of Mosher s ballooning device It appeared as a small pinhole opening in the upper part of the anterior wall of the sac

a little to the left of the midline   This opening was dilated readily with bougies up to No. 34 French   Following the dilatation the patient was greatly relieved for about one month, after which there was gradual return of her difficulty.   She was recommended for external operation for cure of the condition, and was admitted to Dr Lahey's service on September 19, 1924   He operated upon her by the two-stage method   Since then she

Fig 223 —Multiple stricture with irregular dilatation and sacculation of entire esophagus

has reported for observation and bouginage at intervals of two or three months   There has been no return of symptoms of obstruction.

Comment.—By the aid of Mosher's ballooning device it is possible to readily locate the normal esophageal opening which is otherwise in many cases extremely difficult to find.   If the normal opening is found and dilated considerable temporary relief may be expected, but permanent relief can only be obtained by external operation and removal of the sac.

CARDIOSPASM

The cases of so-called cardiospasm have presented some difficulties in locating the cardiac orifice at the lower end of a dilated and sacculated esophagus We have found Mosher's esophagoscopic ballooning device of great assistance in finding the normal passage into the stomach in such cases Once this has been recognized, its dilatation by bouginage has been a simple procedure and effective in the relief of obstruction

THE CHRONIC CARDIAC AS A SURGICAL RISK

Burton E. Hamilton

Among general surgical cases not of an emergency nature, excluding thyrotoxic patients where the percentage of heart complications is high, about $7\frac{1}{2}$ per cent of all the patients of all ages are found to have something in history or physical examination to cause the heart condition to be considered if routine examination is made and history taken before operation

It is possible to group these patients into three divisions

(A) Cases that have *no serious disease of the heart*

This group consists principally of (1) Individuals that can be classed as having *neurasthenia* with *symptoms referred* to the heart (a *cardiac neurosis* or a *neurocirculatory asthenia*) Their complaints usually include some of the following

(a) *"Heart Pain"*—Painful twinges or soreness or aching, usually subcordial or precordial—rarely substernal or referred to neck arm or arms—often most bothersome during excitement or exertion and yet bearing no constant relationship to exertion

(b) *Breathlessness* —This may be associated with exertion or excitement but is apt also to be definitely associated with phobias—sensations of breathlessness or smothering experienced in crowded or closed places

(c) *Rapid Heart Beat* —Persistent, or only on excitement or exertion, but not coming in clear attacks of sharp onset and offset and the rate (though it may never be found below 100) distinctly fluctuating with exertion and rest There is also often unpleasant consciousness of the heart beat—palpitation

(d) *Increased fatiguability*—feeling of "weakness," giddiness, faint feelings—even an occasional syncope

In addition, there may be cyanosis, usually of hands and feet, and not general And often, in addition, sleeplessness, sensations of discomfort in the back of the head, of a tight band across the forehead

CARDIOSPASM

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heart beat slow   They may occur even with rapid heart rates
in some individuals   They can be recognized as extra heart
beats   In most cases they are followed by a "compensatory
pause," the fundamental regular rhythm of the heart being
interrupted but not altered by them   They are to be differen
tiated from auricular fibrillation and (a much less common dis
order) true dropped heart beats   When diagnosed accurately
extrasystoles may confidently be regarded (if the heart exam
ination shows none of the important evidences of disease) as of
no significance in surgical risk   An occasional case has extra
systoles very frequently—at nearly all examinations and even
when the heart is beating at fairly rapid rates—occasionally in
such patients there will be pairs of extrasystoles (and, rarely,
more than two in succession), the intervals between these pairs
or runs of abnormal beats being very short   The whole group of
patients having extrasystoles as the only abnormal point in
cardiac examination   or those who have in addition, only the
complaints enumerated under the group described as "neuro
circulatory asthenia' or ' cardiac neurosis ' withstand surgical
strain as well as normals   I have watched particularly the small
group of patients with very frequent extrasystoles and those
who also have them occasionally occurring in short runs of two
or rarely more and these individuals have withstood the strain
of surgery (and of pregnancy) successfully   It seems hard to
believe that when an average of one heart beat out of every
three or four is abolished and replaced by a probably largely
wasted effort that the heart can perform its duty satisfactorily
under prolonged strain   Nevertheless actual cases, some of
them well along in years (I have in mind cases over seventy and
many in the sixties), with otherwise reasonably sound hearts,
have stood the strain of major surgery and convalescence well
Even the aggravated cases of extrasystoles demand no special
precautions or heart stimulants

    It is wise to explain the heart irregularity in such patients
to anesthetist, nurses and others who will watch the pulse
through and after operation   in order to avoid unnecessary
apprehension

(B) Another less clearly marked group of suspected cardiacs
may be classed as *"possible heart disease"*

This group can include patients with more or less clearly
audible systolic murmurs of different qualities of location, trans
mission, pitch persistence etc Many of these patients know
that they have a heart murmur—usually they have caught the
phrase that they have a "leaky heart" Some have been rejected
at life insurance examinations Naturally they are apprehensive

To this group with systolic murmurs and no other evidence
of heart disease may be added others who have a prominent
apical first heart sound (sometimes mistaken for a presystolic
murmur and used as a basis for a wrong diagnosis of mitral
stenosis) split or reduplicated sounds or third heart sounds
Any combination of the above and in addition a suggestion of
"doubtful" or "slight" enlargement may be encountered Some
of this group have a clear or probable history of rheumatic fever
or chorea It is probable that some of the hearts in the whole
group are damaged and that most of them are not In any
case this group roughly classifiable as "possible" or "not diag
nosable' heart disease, or in some cases "possible" or ' potential"
rheumatic heart disease exists If the clear points justifying a
diagnosis of a significant heart disease are absent, such a group
as a whole offers no apparent increased risk to surgery To col
lect data on this particular group I have kept a record of a long
series of cases that I have examined personally through the pro
longed strain of pregnancy and labor or operative delivery, and
no case has decompensated Of 170 consecutive cases there was
1 death of puerperal sepsis in a case also complicated by signs
of toxemia The heart did not fail

(C) Patients with *significant heart disease*

Close to 2 per cent of a general surgical clinic, excluding the
patients with thyroid disorders have a significant chronic heart
disease Though one cannot briefly state all the criteria for signif
icant chronic heart damage such "true ' cardiacs as a rule with
very few exceptions have one or more of the following points

(1) Clear enlargement
(2) A significant disorder of the heart beat

(3) Signs or history of heart failure
    (a) Of the congestive type (decompensation)
    (b) Of the anginal type (angina pectoris)

(The only important group of chronic cardiacs of a diagnos able and surgically significant nature that does not always have one or more of the above points is a small group of patients who can be diagnosed as congenital, or probably congenital heart)

True cardiacs, patients with *significant chronic disease of the heart* in my experience form the largest and most important single group of patients who have coincident chronic disease within a general surgical clinic

It is not possible, however, to discuss in a valuable way the risk of such "cardiacs" in major surgical operations as a single group   Just as, clearly, one cannot discuss "lung diseases" in a single group   There are several disease groups into which the true chronic cardiacs fall   The most important groups are

    (1) Rheumatic heart disease
    (2) Heart changes associated with hypertension
    (3) Degenerative senile, or *arteriosclerotic heart disease*

Hearts seriously damaged from *cardiovascular syphilis* are much less commonly found in surgical clinics, and *congenital hearts* also form a very small though, in my experience, an impor tant group   (There are, of course, some cases with combined pathology)

Without going to considerable detail the rules for differ ential diagnosis of ' true' cardiacs into the essential divisions of etiologic groups cannot be stated   There is no way of making *the diagnosis of cardiac disease a very simple matter   If the* $7\frac{1}{2}$ per cent made up of suspected cardiacs is to be thoroughly handled in a surgical clinic, the individuals must be examined and classified by someone specially trained in diseases of the heart

RHEUMATIC HEART DISEASE (CHRONIC)

Though this heart disease can be elaborated into a number of subgroups it is of value to discuss it as a whole

Such patients (excluding those that have a rheumatic history, but whose hearts do not show one of the four points enumerated

above) as a group do not have as long an expectation of life and do not stand strain (for example, pregnancy) so well as normals

Out of 136 cases with definite rheumatic heart disease that I have personally examined and followed through major surgical procedures, there have been 6 deaths directly associable with operation or convalescence

The actual percentage of deaths is of little importance   It may well be misleading because of the differing "normal" death rate in the various types of operations included   The patients were all subjected to major operative procedures, carrying an appreciable ' normal ' death rate   Twenty eight of them were pregnant and had cesarean section   As I watched the patients through strain of anesthesia operation, and convalescence, the ease with which they bore the apparently severe strain was impressive

This rheumatic heart disease group briefly consists of patients with enlarged hearts (only a very few have this sign alone), or mitral stenosis or aortic regurgitation, or some combination of these conditions   (The cardiac pathology from the history, the nature of the lesion or the age of the patient being best attributed to rheumatic disease)   They can readily be separated into

(1) A group which has not yet shown congestive heart fail ure (decompensation) or a significant disorder of the heart beat (The common significant disorder of the heart beat in adults with rheumatic heart disease is auricular fibrillation)

(2) Those with auricular fibrillation

(3) Those with signs or history of congestive failure

Fourteen had auricular fibrillation and no failure

Thirty six had congestive failure   (Sixteen of this 36 had both congestive failure and auricular fibrillation)

Thirty one altogether had auricular fibrillation either estab lished or in very frequent attacks   A number of others had brief attacks for apparently the first time following operation, without exception returning to normal rhythm before discharge from hospital

Only one death occurred among the 87 patients without failure decompensation, or auricular fibrillation   This patient had an enlarged heart and mitral stenosis   She had no clear

evidence of failure decompensation, but a history of frequent attacks of 'bronchial asthma"—which may well have been failure. She died instantly and unexpectedly six days after an abdominal operation for therapeutic abortion and sterilization. Two had mitral stenosis established auricular fibrillation and a history of probable failure, but no failure at the time of operation or for a reasonable time previously. One died unexpectedly and suddenly five and one half hours after leaving the table. The other died in a state of shock without clearly regaining consciousness following operation. The other three deaths might well be omitted in a discussion of operative strain. They were pregnant women with gross congestive heart failure who were operated close to term somewhat as emergency operation. One died after several days of general peritonitis and congestive heart failure. The other two died slowly of congestive heart failure.

It is clear that among the cases of rheumatic heart disease it is with those that have established auricular fibrillation, or a clear history or signs of failure, that the greatest risk from surgical strain lies. And in these cases some risk is unavoidable. Patients with rheumatic heart disease and established auricular fibrillation though many carry on with reasonable activity, are as a group distinctly fragile. (See later discussion of auricular fibrillation.)

Patients with severely damaged hearts due to rheumatic heart disease deserve to be handled with great care before, during and after operation. Those with auricular fibrillation deserve digitalization. Those with congestive failure present or recent may be operated upon confidently if they are very carefully prepared and handled during convalescence.

HYPERTENSIVE HEARTS

There are relatively few burdens that cause congestive heart failure except to hearts otherwise damaged, for example by rheumatic, degenerative or luetic disease. Hypertension is a serious heart burden, a large fraction of patients with hypertension die of congestive heart failure. Proper classification of cardiacs must include the hypertensive heart.

Everyone is aware that the kidney and blood condition in hypertension should be studied   Nowadays kidney function tests blood chemistry examination and cell counts as a rule are easily available to a surgeon   Such cases also require a study of the heart condition other than by laboratory pro cedures   Briefly the heart condition in patients with hyper tension is to be studied for

(1) Enlargement
(2) Failure
    (a) Congestive
    (b) Anginal
(3) Disorders of the beat

Auricular fibrillation the most important common disorder of the heart beat throws off blood pressure readings and though patients with hypertension may develop auricular fibrillation they then are actually apt to be classed as cases with arterio sclerotic heart disease and auricular fibrillation   (Clearly—see later—the kidney condition is to be studied in this latter group as well as in the hypertensive hearts)

The most common significant disorder of the heart beat in patients with hypertension (and regular beat) is a *pulsus alternans*   This is discovered while taking the blood pressure as a slight difference in the systolic pressure of alternate beats   The timing of the beats is perfectly regular   The difference in pressure is often no more than 10 mm of mercury   Often the alternation signals to the examiner by an alternation in the strength of the sounds heard when approaching but below the systolic pressure level during blood pressure taking by the auscultatory method

I have found in my records of cases whose heart condition I have examined with a view to determining operative risk 67 cases with marked hypertension and enlargement of the heart apparently secondary to this—clearly hypertensive hearts   The group contains 4 who had gross congestive heart failure and 2 with persistent alternation   Some had extreme degrees of hypertension   As it happens there was only one fatality though all had major surgical operations   The death occurred

in a patient who failed to regain consciousness after anesthesia and died rather abruptly after twelve hours   No autopsy was permitted   One case had hemiplegia two days after operation but recovered   The others stood operation and convalescence well   From my experience it appears that patients with hyper tension and no gross kidney failure are generally regarded as not bad operative risks   One encounters an occasional patient who has been advised against needed surgery purely on the basis of an enlarged heart and hypertension   The cases do stand surgery well but it is scarcely to be expected that they can be as safe risks as normals and they justify careful estimation of their heart as well as kidney condition and care in preparation

ARTERIOSCLEROTIC HEARTS

I have selected 37 patients whose cardiovascular condition I examined before operation with a view to determine operative risk and who had unmistakable significant heart damage which could best be attributed purely to arteriosclerotic changes   The principal points used in selecting this group were briefly   ab sence of rheumatic or luetic history   absence of diastolic mur murs or hypertension   advanced age with often clear evidence of extracardiac sclerotic changes   and one or more of the fol lowing findings

  (1) Gross enlargement of the heart
  (2) Auricular fibrillation or *pulsus alternans*
  (3) Congestive or anginal failure
  (Often there was also electrocardiographic evidence of myo-cardial disorder)

The above 37 patients include many obviously poor cardiac risks   All had major surgical procedures   Three died   One had a large adenoma of the thyroid chronic phthisis and established auricular fibrillation   She failed to return to consciousness after anesthesia and operation   and died in about sixteen hours   A second case with *established auricular fibrillation* died suddenly during induction of anesthesia   Autopsy revealed no immediate cause for death but gross degenerative heart changes   The third with a grossly enlarged heart   no clear failure and a normal

rhythm survived gall bladder operation and appeared to be
doing very well but on the twelfth day went into a state of shock
and died two days later with symptoms of a coronary occlusion
Autopsy showed a very large heart with a large infarcting area
(which must have antedated the operation)

The percentage death rate from the figures given means
little But it is clear that patients usually elderly even with
gross heart changes attributable to arteriosclerosis with angina
pectoris and with congestive failure (see later) can be prepared
for operation and operated safely in the great majority of cases
Many of this group have in addition some evidence of kidney
damage In this group again the added surgical significance of
an auricular fibrillation or failure or both appears

Clinical cardiovascular syphilis is not a common complicating
disease of surgery I have personally seen but a handful of Class
A cardiacs justifying a diagnosis of cardiovascular lues who were
operated One of these cases had prolonged congestive heart
failure only partly relieved by rest in bed for several weeks
before operation

CONGENITAL HEART DISEASE

Patients with congenital heart disease form a tiny but
particularly interesting group of surgical risks

In my own experience there has been what is probably an
unduly large death rate and incidence of alarming unexpected
symptoms following operation

Altogether one can classify a small fraction of 1 per cent
among children and young adults (rarely a middle aged or elderly
patient) who require major surgery as having a definite or
probable diagnosis of congenital heart By far the largest num
ber of these are cases that have a loud (and often sustained)
systolic murmur with a thrill usually appreciated best at the
left of the sternum toward the base or near the midportion of
the heart and not transmitted to the neck some have as well a
prominent pulsation with the heart beat to be felt at the left
of the sternum toward the base of the heart Distortion of the
heart shadow on x ray plates or fluoroscopic examination or

abnormal ventricular complexes in electrocardiograms in some cases add weight to the probable diagnosis. This number, as a rule, have no clear cyanosis, and give a history of leading a normal life without impressive embarrassment referable to the heart.

A group of 22 such patients, including two with drumstick fingers and cyanosis, had major surgical operations resulting in 4 deaths.

(1) One survived one major operation and died of tetanus three weeks after a second major operation. (Scarcely a significant case in these series)

(2) A second case operated for a lung abscess died with cerebral symptoms; no autopsy.

(3) A third died six days after a laparotomy, suddenly and unexpectedly.

(4) A fourth case previously without clear disability, cyanosis or drumstick fingers, showed violent heart action with normal rhythm, rapid heart rate (130–160), and alternation of the heart beat; rapid deep respiration; pallor. There was no congestion. This continued for ten days after a cesarean section, when death occurred apparently from exhaustion. A few days before death she showed marked pulsus alternans. Autopsy showed a large opening in the interventricular septum, and no other cause for death

(5) A fifth case, with a sustained systolic-diastolic murmur, drumstick fingers and persistent cyanosis, but actually without marked disability, showed (suddenly) the same distress described in the last case immediately after cesarean section, and slowly recovered after several days.

It is dangerous to draw conclusions from small groups of cases that may prove to be very unusual. But in a considerable experience in observing the response of patients with significant heart diseases to surgical and obstetric strain, this small group of patients with congenital malformations stand out as furnishing some unpleasant surprises. Nevertheless, most of this small group tolerated surgical strain without the slightest cardiovascular embarrassment. One can hardly refuse them needed surgery.

AURICULAR FIBRILLATION

In considering the whole group of cardiacs it is evident that patients with *established auricular fibrillation* furnish a delicate class of patients for surgical strain Most of them have severely damaged hearts in addition to the disorder of the beat If one watches a large group of otherwise unselected patients with established auricular fibrillation (not including those with fail ure) outside of a surgical clinic one finds that many of them carry on with reasonable activity very well indeed An occa sional case however dies suddenly and unexpectedly without clear cause to be found at autopsy An occasional case has a fatal embolus from a thrombus formed within the left heart Some have evidence of an embolus and recover

Nevertheless out of 150 unselected cases that I have watched who had established auricular fibrillation and were subjected to major surgical operations 143 survived Many of these patients had congestive failure before operation and even at the time of operation The group includes patients with rheumatic arterio sclerotic heart disease and many who were thyrotoxic

The deaths were

Three sudden and unexpected   (One autopsy failed to show cause)

Three promptly (about twelve to twenty four hours) after operation in the general picture of shock

One two and one-half days after operation with prolonged symptoms of distress suggesting shock

Auricular fibrillation (see Sudden Alarming Sudden Symptoms Referable to the Heart Following Operation) is a significant dis order of the heart beat in fact the most important common dis order It is clear that it does not in itself contraindicate surgery It inevitably adds a slight risk It indicates careful digitalization

Discussion of the chronic cardiac as a surgical risk neces sarily includes methods of preparing the patient for operations Whether or not digitalis or other heart drugs are to be used is always to be decided This is a much discussed question and its significance is probably overemphasized but it cannot be avoided

The use of digitalis in surgery is not clearly understood

The dosage is pretty well established. A grain and a half for every 10 pounds of body weight in twenty-four hours (or a single dose) or $1\frac{1}{2}$ grains daily thereafter of a standardized powdered leaf or its equivalent in some other form. But all digitalis taken within a period of about two weeks before digitalization is to be considered. Thin patients, in my experience, often require more, fat ones less, than their theoretic allotment per pound. (It is likely, as discussed by Pardee, that the size of the heart is a factor in dosage.) Some stay satisfactorily digitalized on $1\frac{1}{2}$ grains   Others require more. Occasionally a case will only tolerate a smaller amount, but standard dosage is distinctly worth bearing in mind.

Indications for the use of digitalis in surgical strain are a matter of opinion and authority. Experience apparently leads men who are qualified to speak to widely differing opinions.

Digitalis appears to me to be a relatively safe drug. With reasonable doses it is not uncommon to cause unpleasant general symptoms which clear without ill effects within a few days after its withdrawal. It is possible to poison hearts with it and do appreciable harm   This is very uncommon. The only cases that I have personally seen where I am confident that it has done serious harm when given in reasonable doses are a few individuals among patients during or convalescing from acute infections, particularly diphtheria, rheumatic fever, and some of the "prevalent epidemic infections." It is less easy to be sure that it has done real harm, though an occasional case suggests it (for example, by aggravating blocks, causing dissociation, or extrasystoles and paroxysmal tachycardia), in some individuals with chronically or acutely damaged heart muscle, from other causes than acute infections.

The "whip-like" action of digitalis on the heart is shown clinically rather indistinctly or at any rate inconstantly, and where such an action has been apparent there is often little solid evidence that the patient's general welfare has been materially aided by this action. Its blocking, slowing effect on normal rhythm is often not clear, and it is doubtful whether it is beneficial to slow by drugs a heart which is beating fast, but in a normal rhythm and as a normal response to a strain.

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The use of digitalis in surgery is not clearly understood

Digitalize those with auricular fibrillation

Choice of anesthetic   We have had no experience with chloroform   The easiest anesthetic for the surgical problem is very likely the best choice   Cardiacs have tolerated ether, gas, gas oxygen   ethylene, local, spinal, sacral   preoperative morphin scopolamin or both, in various combinations according to the judgment of the moment without clear indications for a special choice appearing   Certainly cardiac disease does not in general contraindicate inhalation anesthesia   However one instinctively chooses a local anesthesia where this is feasible from the nature of the operation and the disposition of the patient   To my mind the services of an expert anesthetist are distinctly valuable in reducing strain of operations on cardiac patients

Nowadays preoperative routine examination has developed considerably in the endeavor to sort out the poor risk patient for special consideration   This development has been chiefly along laboratory lines   Elaborate routine laboratory examinations (such as simple blood chemistry and kidney and liver function tests) are relatively easily organized in a modern hospital   Some of them are clearly of value for example in detecting an occasional diabetes and very rarely in detecting an unsuspected kidney failure   and they do this more accurately perhaps (granted skill and care on both sides) than preoperative examinations by a physician

The 7[1] per cent of patients whose heart condition deserves consideration however cannot be handled by indirect examinations made by technical methods alone   From time to time one hears routine technical preoperative heart examinations suggested with a view to determining operative risk   Electrocardiograms will distinguish most of the significant disorders of the heart beat (often they fail however, to report a pulsus alternans which is always of significance)   Certain myocardial changes probably of significance and not clearly distinguishable clinically, are suggested by cardiograms alone   It is true that routine electrocardiograms occasionally discover an unsuspected disorder of the beat, such as auricular flutter   They will, however, not discover congestive heart failure, for example in many

patients with angina pectoris the history alone tells the story They cannot often even suggest whether a simple tachycardia is from neurosis thyroid intoxication or secondary to some serious condition They do not in any real sense serve as a test of cardiac function They are of definite value *as an adjunct* to cardiac diagnosis to a physician of experience trained in heart diseases A truly valuable direct test of the heart s function (capacity for strain) would be highly desirable But it seems unlikely that any such tests can be devised which will be of practical value in determining operative risk For several years I have recorded (1) Vital capacity (2) The results of a simple cardiac function test in large groups of cardiac neuroses possible cardiacs and true cardiacs at every visit of these patients during observation through pregnancy and puerperium Both tests clearly have proved inadequate to separate sheep from goats So far as determining operative risk is concerned such procedures do not fill a prominent position

If true cardiacs in a surgical clinic are to be handled comfortably they should be considered as a special group and cared for by some one familiar with heart diseases and the response of cardiacs to surgical strain

The chronic cardiac as a surgical risk is indeed a part of a larger problem—the relief of chronic disability from cardiovascular disease This discussion of course only briefly considers their surgical risk It shows however that patients with severely damaged and failing hearts can when necessary be prepared for operation and operated upon without undue risk

In addition our experience has shown that many of the most gratifying clinical results within the surgical clinic have been among patients disabled with heart disease where disability has been immensely relieved by the surgical removal of a coincident burden We have reported the delightful results following thyroid surgery in a large group of patients with prolonged disability from congestive heart failure associated with thyroid toxicity There is also a small but satisfactory group steadily growing of cardiacs relieved of disability by removal of surgical burdens such as a diseased gall bladder or large pelvic tumor

CONGESTIVE HEART FAILURE AND ANGINA PECTORIS IN SURGICAL PATIENTS

Burton E. Hamilton

In the preceding discussion it has been shown that severe heart disease does not, by and large, make major surgical procedures unduly hazardous It has also been shown that patients with severe degrees of heart failure can, when necessary, be operated with a markedly low mortality It has not been shown that patients with severe heart disease can be operated safely with out special care or with preparation merely consisting of heart stimulants

Though sudden death can and does occur from a disordered heart, not in failure, the majority of cardiac deaths occur in more or less prolonged ' heart failure,' and avoidance of heart failure is the main object in the care of chronic cardiacs With the advance in knowledge of hearts in the last score of years, it has become clear that hearts fail in just two ways

(1) Congestive heart failure

(2) Anginal heart failure

CONGESTIVE HEART FAILURE

Congestive heart failure is a failure of the heart to pump along the blood so fast as it is fed to it from the veins The symptoms and signs are associable with the consequent venous engorgement

Systemic Veins—General engorgement of the systemic veins occurs in congestive failure, but this is only easily demonstrable by a few signs, namely, engorged neck veins with the patient relaxed and head and neck elevated so that the neck veins are higher than the heart This is not always clearly demonstrable in failure, and may be caused by other conditions offering

obstruction to the flow of blood from the neck veins into the
mediastinum   *Engorgement of the liver*   *Enlargement* which on
direct examination may not always appear symmetric for ex
ample the left lobe only may be felt as an epigastric tumor
which in some cases suggests a neoplasm   *Tenderness* This
may be absent or marked and need not vary directly with the
apparent size of the liver   *Pain*   This rarely may be severe com
monly more a sensation of fulness or pressure than pain in the
epigastrium or in the right upper abdomen   There is some
times ascites (even without clear evidence of edema elsewhere)
General demonstrable edema is inconstant in degree and often is
not present   It is usually a more or less retarded result of con
gestive heart failure   It is not a cardinal sign   Engorgement of
the *pulmonary veins* shows itself by diminished vital capacity
and in increasing degrees *breathlessness* which nearly always is
associated with orthopnea   *rales* particularly in dependent
portion sometimes localized at one lung base only   (Rarely
pleural effusion which may be apparently unilateral)   *Cough*
which may be productive   *henoptysis* as pink stained sputum
in association with a general edema of the lungs more commonly
as varying amounts of fresh blood or blood flecks in sputum
Though hemoptysis is usually only present in severe degrees of
congestive failure particularly in mitral stenosis small amounts
of clear blood may be expectorated with no other clear signs of
failure present

Congestive failure may be relatively mild and chronic the
patient up and about though handicapped by some or all of the
above symptoms   It may be severe and may be of very sudden
onset   It may be fleeting or persistent   The degree rapidity of
onset and course vary greatly   Though the physical signs and the
subjective symptoms from the congestion of both pulmonary and
systemic veins are usually simultaneously present   there may be
considerable difference in the relative intensity of the signs in
the two venous systems   Occasional cases complain bitterly
and only of some special group of symptoms

Without discussing the more clearly   medical   problems
causing various confusions of diagnosis that are possible from

a congestion of the pulmonary veins which suggests pneumonia, phthisis, neoplasm, it is easy to see the confusion in surgical diagnosis that can result from congestive heart failure when the pulmonary symptoms are slight, or not complained of by the patient, but when upper abdominal pain and tenderness are prominent.

The danger is well known of performing an abdominal operation on a patient with upper abdominal tenderness or pain caused by a liver congested by heart failure which wrongly suggests some surgical condition. In my experience the mistake is rarely made, but it is by no means unknown. The following case history is related for illustration:

A man aged fifty-five gave a history of congestive failure associated with hypertension for more than one year. Though orthopneic and breathless and with evident physical signs accounted for by venous congestion, he did not complain about his cough and breathlessness, but did complain bitterly of almost constant abdominal distress. His abdomen was distended, tender in the upper half, less toward the left. No mass could be felt because of resistance, but the upper left and center were dull to percussion. There was no general edema. The heart was regular and not very rapid. He had a "good pulse" with hypertension, but a pulsus alternans. He had appendectomy eight months before entrance to this clinic, without relief, and three months before entrance his gall-bladder was removed, without relief. His persistent congestive failure increased and he died (three weeks after entrance) from this alone. General edema did not appear until a few days before death.

Both the patient and his family were convinced that the trouble was from some abdominal condition. I can well understand that it would be easy to be led into an abdominal operation in this case by the patient's pleadings if the signs of failure were not very clear. Many single case histories could be given where at any rate for a time the diagnosis of congestive failure presented marked difficulties in surgical diagnoses even when this particular point was fully appreciated.

It is theoretically possible for a patient with congestive heart failure to have coincidently an acute abdominal condition. In

the chances are against it   In my experience, where this honest
doubt has arisen, *no mistakes have been made by postponing
operation*   With one possible exception the cases that I have
seen have proved not to have any complicating acute surgical
abdominal condition   In a few cases operated the abdominal
signs have been so misleading that abdominal section was per-
formed in full knowledge of the failure and nothing was found
but the congestion

Though the patient described survived his operations it is
not always safe to disregard a congestive failure and operate

An elderly woman wished a small wen removed because of
unsightliness   She was sent to hospital elsewhere and the wen
was readily removed   After operation it was noted that her
heart was irregular and cardiologic examination showed slight
orthopnea rales at the bases of both lungs slightly enlarged
liver, a large heart rate around 120 pulse count 90, irregular,
but not too obviously so to escape notice at casual examination
She had clearly auricular fibrillation and congestive heart
failure   The patient fairly enough was given digitalis   The
next day she had an embolus to a leg resulting in a gangrenous
condition   the patient became desperately sick   amputation
was indicated and performed but the patient did not survive
This unusual case illustrates what a chain of misfortunes may
occur in patients with auricular fibrillation, with congestive
failure   The original operation perhaps in no way caused
death but the sequence of unhappy events terminating fatally
happened to occur after the patient went to hospital and was
operated upon   Briefly thrombi may form in the left auricle,
for example in heart failure   They probably form more easily
where auricular fibrillation is also present and no doubt still
more frequently when also the mitral valve is stenosed   The
thrombi may become emboli   Such emboli cannot of course be
predicted but there is a tendency for them to occur during or
shortly after a congestive failure   When failure can be relieved
it is well to wait for three weeks of rest in bed before allowing a
patient exertion (or in the connection now discussed) to consider
operating upon them   It is possible for intracardiac thrombi to

become adherent to the endocardium, for them to become at all firmly adherent, I am told by pathologists, takes at least three weeks. Clinically, whether or not it actually prevents some emboli, the practice of delaying an operation for three weeks after relief of congestive heart failure appears to have been at any rate associated with a highly satisfactory mortality in such cases in my experience. Also, making this rule inflexible undoubtedly has caused us to give a long and generally beneficial rest in bed to patients who have been quickly relieved of their gross signs of heart failure, in spite of the temptation of the arguments of patients and our own natural desire to have the operation over quickly.

A woman aged forty, with a history of rheumatic fever in girlhood was admitted with mild congestive heart failure of several weeks' duration. The heart showed mitral stenosis, the rhythm was regular. The failure cleared within forty-eight hours. Later it was incidentally found that she had had severe dysmenorrhea for several years. Rectal examination suggested a large pelvic tumor. The patient was obviously in good condition a few days after entrance, but was rested for three weeks because of her congestive failure at entrance before either examination and operation, if indicated, was attempted. Two and one half weeks after entrance she had an unexpected attack of auricular fibrillation with rapid ventricular rate and return of congestive failure. The failure cleared after slowing of the ventricular rate with digitalis, but operation was again postponed for at least another three weeks after this failure. Two weeks after the second failure cleared, embolism occurred, simultaneously blocking both femorals. The emboli were promptly removed surgically, but the patient died in twenty-four hours. Necropsy showed other emboli in particular one occluding the mesenteric artery which appeared as the most prominent cause of death. This case emphasizes from one point of view the advisability of at least three weeks of complete rest after a congestive failure. If an operation had been performed before either sudden event, and since the patient appeared in good condition at both these times, operation would have been done but for the

rule of three weeks rest after a failure it would have appeared to us and all concerned that the events over which we had no control and the deaths were at any rate in part excited by the operation

Altogether 144 patients under my personal supervision have had gross congestive failure at entrance to hospital and have later had major surgical operations 8 operative deaths Many of the above cases were actually in failure at the time of operation a large portion of these had thyroid toxicity and their failure could not be relieved by any means before operation the remainder were obstetric patients in circumstances which forced abdominal sections even though the patients were in severe degrees of failure The results have been surprisingly good but in emphasizing the fact that our experience has shown that patients with severely damaged hearts with auricular fibrillation and even those who have had failure and even those that still have it if need be can be operated with surprising safety it should be emphasized that

1 Every effort to relieve failure has first been made

2 A prolonged preparatory rest in bed has followed relief of failure before operation

3 Those with failure persisting after all reasonable efforts have been operated only when the most favorable time appeared

As a rule the most unpromising risks at entrance when carefully prepared and when operation has been patiently delayed for the most favorable moment have survived major surgery with great ease when the test came

A recently operated case illustrates this Mrs C aged sixty-six years had been increasingly breathless on moderate exertion for several years and for five weeks orthopneic She had been in bed for at least a week before entrance but in spite of this still showed orthopnea rales in lung bases respiration hurried and shallow neck veins prominent the liver was engorged and tender and the abdomen distended She had edema of the legs and feet The heart was grossly enlarged and moved the chest wall forcefully with each beat there was a loud systolic murmur the rate was rapid and rhythm regular but every alter

nate beat was weaker than the others by about 10 mm. of mercury in the radial systolic pressure. She was feeble, apprehensive, nauseated, sleepless. The signs of failure persisted for two weeks. Three weeks later the patient was comfortable, reassured, sleeping well, but, of course, still in bed and spared every possible exertion, even being fed by her nurse. She survived a subtotal thyroidectomy (adenomatous goiter) without appreciable reaction. Several weeks later the patient was prepared for operation for a large fibroid of the uterus. The morning of operation she felt nauseated, and vomited once. She gave a history of occasional nausea and vomiting attacks associated with some upper abdominal discomfort, usually on the left. The patient vomited several times during one day, then continued in good condition, and three weeks later survived removal of the uterus and of a large gall-bladder filled with stones. She had an uninterrupted recovery unusually free from discomfort. Why operate on such a patient? Removal of these heavy burdens from a severely handicapped cardiac patient in this case, as in many others, resulted in a definite improvement in ability.

Heart failure of the congestive type does not follow surgical strain unless previously present. It is only found in cases with coincidently badly damaged hearts, and even among patients with badly damaged hearts, but not in failure at the time of operation it is extremely rare for congestive failure to appear as a result of operation. This should be valued as showing the operability of chronic cardiac patients, but, as shown in this and the preceding discussion, it should not justify a general disregard of the heart condition in surgery.

An understanding of heart failure is of importance to a surgeon for the following reasons:

1. To aid in avoiding operating on supposed surgical abdominal conditions that are really more or less obscure heart failure, either "congestive" or "anginal."

2. To avoid precipitate operation on patients in unsuspected serious heart condition which may be improved by intelligent preparation.

3 Most important of the three To avoid refusing needed
operation to patients because of an apparent cardiac decom
pensation which does not exist but is merely a cardiac neurosis
or because of a real failure which when properly handled per
mits reasonably safe operation with no more risk than would
cheerfully be accepted by all concerned

ANGINAL FAILURE

Among the middle aged or older patients in a surgical clinic
a small number are limited beyond a more or less fixed point
in all forms of effort by discomfort constriction or fulness or
pain   described at times as soreness aching burning sensa
tion located substernally or close to the epigastrium to right
left or both radiating or not to neck throat jaws arm or
arms rarely radiating to the back or downward   The sensation
is produced by effort or excitement and is relieved promptly by
rest   It is usually relieved also quickly by vasodilators such as
nitroglycerin

This group of patients is much smaller in my experience in a
surgical clinic than the group with congestive heart failure
Approximately 12 cases that I have personally examined have
had major surgical operation (not including nose and throat and
oral operations) there have been no deaths

As is well known a number of clinics have reported small
series of patients of this type who have had surgical removal of
some of the cervical sympathetic ganglia in an effort to relieve
angina   The majority have survived operation

General treatment of patients with this chronic anginal
failure consists principally in a removal of burdens such as
limiting exertion rest after meals weight reduction and so
forth A search of such patients for surgically removable burdens
is clearly indicated In my short series of cases with chronic
angina pectoris who have had a significant surgically removable
burden the patients have stood surgical strain without alarming
developments and a few who had toxic adenomata of the thy
roid have shown definite amelioration of their disability following
the removal of the burden

A very striking example is a man of sixty five with chronic angina for six years, and an attack suggesting a coronary occlusion with recovery nine months before operation During the seven months before operation there was increasing nervous irritability and a weight loss of 40 pounds Though up and about effort beyond slow walking about for short distances was stopped by angina The patient had had an adenoma of the thyroid the size of a hen's egg for many years Although he had consulted excellent medical opinion it was considered that the adenoma was not a factor in his health until his general practitioner became suspicious The patient proved to have a basal metabolism ranging from +38 to +52 Following one week s observation in hospital the adenoma was removed under local anesthesia He had an average reaction to operation shown in slight elevation of pulse temperature and respiration, with moderate increase of the usual nervous irritability for thirty six hours and made an uninterrupted recovery There was no complaint of angina at this time He has been able to extend his activity enough to resume his regular business and since operation has not felt angina

Such easy opportunities to remove heavy burdens from patients with chronic angina unfortunately do not come often to an internist We should look for them and seize them

It is seldom that chronic angina suggests strongly a surgical condition An occasional patient with gall stones will have pain radiating to the regions more characteristically invaded by angina pectoris But observation for a reasonable time nearly always will clear the confusion because of the essential dependence of the symptoms of chronic angina on exertion Not too uncommonly the same individual will have coincidently a chronic angina pectoris and gall stones

Within the last few years it has become general knowledge that *coronary occlusion* as a sudden clinical event can often be recognized And it is well known that this disorder can often confusingly suggest an acute surgical condition of the upper abdomen The general subject of the diagnosis and prognosis of coronary occlusion has naturally been the subject of a very

large number of articles in the last twenty years   I will deal
with it briefly, from my own experience, only so far as it seems
to me to concern surgeons

It is a possibility to consider in diagnosis of surgical condi
tions of the upper abdomen

Simple Points in Diagnosis —It occurs in middle aged or
elderly people, those who previously have had "chronic" angina,
or in patients without previous disability   In a series of 100
consecutive cases with chronic angina or coronary occlusion or
both that I have personally studied the average age was sixty
one the youngest thirty seven, there is no upper age limit, 74
were men

The angina may differ in degree from mild to very severe
requiring stupefaction of the patients by sedatives for any
appreciable relief   It is felt most commonly in the epigastrium
or under the lower end of the sternum, and may radiate to or
center in the regions previously described for "chronic angina "
It occurs independently of previous exertion and typically is
not promptly relieved by rest and is little affected by vasodilators

There is the general picture of shock which differs in indi
vidual cases from very mild to extreme   There may be nausea
and vomiting   Anxiety is common, but is often absent in those
having mild angina   The angina may persist indefinitely, or
may improve and disappear after hours or days   perhaps to re
turn after hours or days

If the patient is seen near the onset of the attack there is
seldom anything about the examination of the heart to help the
diagnosis   The decision is made in the absence of a clear sur
gical abdomen, in the presence of a patient old enough to have a
coronary occlusion, and in the presence of angina

The blood pressure tends to be low   but in rare cases a hyper
tension will persist through coronary infarction   The heart
rate also, though often quickened to above 100, may remain
slow

Hours or days later any or none of the following signs may
develop   Pericardial rub, extrasystoles, paroxysmal tachycardia,
dropped beats, a new systolic murmur, changing heart sounds,

faintness particularly of the first sound gallop sounds, embolism pulsus alternans Heart failure of the congestive type may develop Some irregular fever is common and moderate elevation of the white blood count is the rule during the first weeks of a coronary occlusion

A single electrocardiogram taken during an infarction from a coronary occlusion often is not helpful It sometimes adds evidence If compared with previous tracings or if repeated during the progress of the infarction it may be diagnostic

It is most important to realize that none of the physical signs and laboratory findings are constant and that any rule may fail There is no reliable simple rule for diagnosis A clear cut case is certainly as easy to diagnose (after experience and with the possibility in mind) as a case of gall stone colic The less clear cases are often extremely unsatisfactory to diagnose and occasional errors are actually to be expected Early diagnosis particularly frequently has to be made on very scanty findings Unlike confusing situations presented by congestive heart failure in surgical diagnosis confusing situations when coronary occlusion may be suspected often do not permit of a safe decision to *delay* operation

In such a situation a knowledge of the actual clinical diagnosis of the various acute upper abdominal disorders must be consciously weighed against the actual clinical diagnosis of coronary infarction and a decision made *without* waiting developments

Case I —An apparently healthy and robust man of sixty nine leading an active business life following a customary round of golf ate a heavy luncheon and immediately felt a dull pain in the epigastrium enough to decide him to walk home instead of playing more golf in the afternoon He vomited once, a portion of his luncheon pain was not severe but unpleasant He called his physician who ordered an enema which was followed by some relief He had a comfortable night and was up and about in the morning feeling nearly as well as ever, and stayed quietly around his home all day in comfort The next

morning the pain returned but not severely His physician a
very careful man drove him to a hospital for x ray examination
in particular for suspected gall bladder disease   The examina
tion was negative Consultation with an experienced and able
surgeon resulted in an opinion of nothing surgical   He returned
to his home Five days after the onset the patient was com
fortable nearly all the time but more or less conscious of a sense
of pressure in the epigastrium The sense of pressure moved
upward under the sternum   It was not referred elsewhere He
tolerated a light diet well his bowels moved regularly he had a
slight fever and a white count of 15 000 His physician dis
cussed the case with an internist who suggested the possibility
of coronary occlusion   During the eighth night the substernal
discomfort became severe and required morphin He was seen
by me on the ninth day He appeared moderately pale and
anxious His heart was regular with an occasional extra beat
noted for the first time there was a loud systolic murmur said
by his physician to be a new development There were no signs
of congestive heart failure Heart rate 102 Blood pressure
130/100 in both arms

Diagnosis —Coronary infarction

Prognosis —About an even chance of being alive in three
weeks

Treatment —Absolute rest in bed night and day nurses light
est diet sedatives no stimulants

The patient was comfortable until toward the next morning
the pain became aggravated the heart showed very frequent
extrasystoles and short runs of extrasystoles The following day
there was a sudden pain in the right leg the veins of the lower
leg became congested no arterial pulsation could be made out
in the popliteal artery or its branches and a few hours later a
similar condition appeared in the left leg The patient sank
into a state of shock and died about thirty six hours later eleven
days after the original complaint of epigastric distress following
a heavy luncheon

This is a rather typical case of coronary occlusion It is
easy to diagnose after the evidence is in Though such cases are

very common, and the diagnosis of a possible surgical abdominal condition is often considered before the heart is thought of as a cause, I believe very few such cases are mistakenly operated upon

The following case is clearly unusual

Case II —A clergyman, robust and active, had many attacks of typical gall stone colic x Ray examination showed gall stones He declined operation and was free of pain for several months During this time he went gunning, climbed hills and played golf without discomfort A sudden attack of epigastric pain and vomiting confined him to bed for one day when the pain improved but persisted for several days as a nagging discomfort, so that he decided to be operated He was operated and a gall bladder containing many stones was removed He had fever for the first four days only, and had an uninterrupted recovery until the fourteenth day, when he complained of severe substernal pain He was then found to have a loud systolic murmur and extrasystoles The following day he had a pericardial rub He sank into a state of shock and died on the seventeenth day after operation, about three weeks after his original "gall bladder" pain

Autopsy showed an infarction in the left ventricular wall involving a large area the pericardium was adherent over this area and there were large thrombi within the ventricle partly adherent to the wall The condition must have antedated the operation

Somewhat similarly, a coronary occlusion occurring by chance during or following a surgical operation is by no means unknown This situation is apt to be overlooked

A coronary occlusion with sudden violent symptoms suggesting an acute surgical emergency is not unusual Following is a case which further illustrates the confusing possibilities of this condition

A man aged forty five with a vague history of upper abdominal discomfort of several months duration relieved by alkalies, suddenly complained of violent and persistent epigastric pain,

requiring $\frac{3}{4}$ grain of morphin in a few hours with little relief
He had a rapid pulse a temperature of 100° F and a fear of
impending death A consulting surgeon operated upon him as a
surgical emergency There was nothing found in the abdomen
except a moderate amount of free fluid The liver appeared
somewhat enlarged The gall bladder was drained but the
surgeon felt that he had operated upon a patient with a coronary
occlusion He was seen by me twenty four hours after operation
in a dying condition he was delirious the temperature was
104° F the heart rate 140 he was pulseless There were râles
at the lung bases Though there was little clear evidence for
this it appeared to me particularly in view of the negative
abdomen at operation the large liver found the rales at the
lung bases that the patient had had a gross coronary occlusion
and now had congestive heart failure Autopsy showed a very
severe acute pancreatitis and a normal heart

Though the above case was not saved by operation it seems
to me important to realize in a similar situation

1 That a diagnosis of coronary occlusion offers a not very
cheerful prospect to patient or physician The patient has a
good chance to survive but this probably depends largely on
conditions that are entirely beyond control and will not be
much lessened by an operation Though it is a deplorable thing
to operate thoughtlessly on a patient with coronary disease an
occasional coronary occlusion or acute pancreatitis presents a
picture that is actually undiagnosable

2 A missed diagnosis of acute pancreatitis or ruptured
gastric or duodenal ulcer may directly result in the patient s
death proper diagnosis and operation may save life and return
him to full ability

THE TREATMENT OF EMBOLI IN THE PERIPHERAL VESSELS

FRANK H. LAHEY

THE publication by Key[1] of the results of his experience with embolectomy demonstrated the possibilities of conserving by this procedure extremities which would otherwise be lost

Key in this publication reported 45 cases 13 of which he states had a happy outcome

To the above record Soderlund[2] added 17 cases making 62 cases in the literature with good results in no less than 24 over one third of the cases

We have performed embolectomy three times in this clinic upon 2 cases of femoral occlusion one bilateral all of which died later of multiple or further emboli The experience how ever with this operation has convinced us of the soundness of the procedure and we believe will enable us to preserve some extremities also

The details of 4 cases are presented together with certain remarks concerning emboli and embolectomy gained from those cases and from a review of the literature on this subject

All cases reported in the Scandinavian literature have been operated upon with local anesthesia This seems essential not only because the patients upon whom this operation is done are poor risk cases but also because general anesthesia possibly pre disposes to other emboli

The diagnosis of the lodgment of an embolus in an extrem ity has not been difficult The sudden pain the change in color (blanching) of the extremity the loss of pulsation in the vessel distal to the embolus and the ability to demonstrate the point

[1] Acta Chirurgica Scandinavica vol 54 1922
[2] Ib I vol 59 Fasc III 30 xi 1925

at which pulsation of the artery ceases makes the demonstration of its existence and location fairly simple   The diagnosis is also often made easier by the fact that these patients suffer from diseases prone to produce emboli such as cardiac failure valvular disease etc as in our cases

The most common points at which emboli lodge are at the division of a vessel as at the bifurcation of the aorta at the profunda branch in the popliteal and in the axillary where the subscapular is given off

When an embolus is located at the division of the aorta common iliacs common femoral popliteal and axillary arteries and sometimes upper brachial the danger of gangrene is grave

Regarding brachial embolism Gustaf Söderlund [1] who reports 2 cases of embolectomy one of the popliteal and one of the brachial states that emboli in the brachial are much less liable to produce gangrene than the popliteal but that it has been his experience that even if gangrene does not occur there is great disability from loss of functional power in the hand

The danger of secondary thrombus formation increases with the time elapsed after the embolus has occurred   Key has seen beginning secondary thrombus formation two hours after embolus and again has not seen it in late cases

Exposure of the vessel shows the location of the occluding clot very clearly   Pulsation will be seen to cease at the upper most limit of the clot and the vessel from the upper level of the clot downward is of distinctly smaller caliber   Palpation demonstrates the solid cord like consistency of the clot filled vessel

A large number of the reported cases have been operated upon from one and a half to five hours after the lodgment of the embolus   Our cases were operated two and a half four hours and forty five minutes respectively after occurrence of the embolus   Cases are reported however which were operated upon much later one four and a half days after and of course unsuccessfully   It is stated that in no case is embolectomy successful when done twenty four hours after the occurrence of the embolus
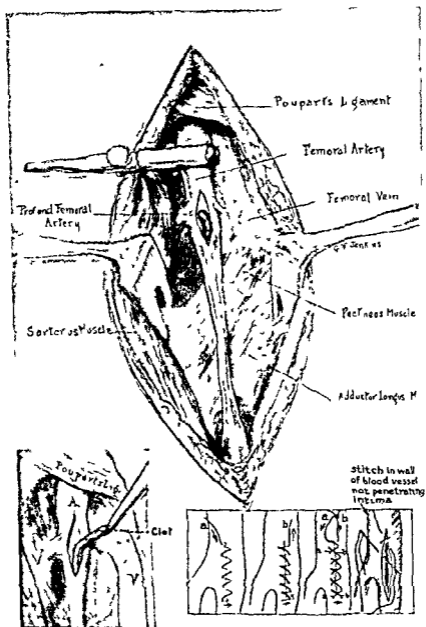
Fig 224 —Showing exposure of vessel The incision in the vessel and application of the clamp Inserts showing removal of the clot and suture of the vessel

The removal is begun by first applying a rubber-covered vessel clamp to the vessel sufficiently far above the upper limit of the embolus so that there may be adequate room for the arteriotomy

An incision 1 cm in length is then made in the artery just at the upper level of the embolus and the embolus extracted both by pulling gently with a pair of forceps from above and milking upward by gentle pressure on the vessel walls from below

Fig 225 —Showing incision also below clot a method of irrigating through vessel with citrate solution Note clamp applied below to prevent clot escaping into vessel below

At times it was not possible in our cases to extract the embolus by this means In such cases uterine sounds small blunt curets and small gall stone scoops have been employed to loosen them Before such measures are employed however,

it is wise to place a vessel clamp below the lower level of the embolus and to do another arteriotomy at this level to permit the escape and to prevent pushing the fragments further downward in the lumen of the artery   If fragmentation of the embolus occurs, a syringe and catheter may be employed to wash the lumen free of fragments with 2 per cent sodium citrate solution   Following the removal of all of the embolus, including any of its fragments, the upper arteriotomy wound is closed   the upper clamp loosened and blood allowed to rush through the sutured and previously plugged portion of the vessel, thus serving to remove any remaining clots from the lumen and to demonstrate its patency   The clamp is again closed and the lower arteriotomy wound then sutured

In this connection it is well to have in mind the advice of Key regarding the treatment of an embolus lodged at the bifurcation of the aorta   He states that since the condition of those patients will not permit the exposure of the aorta at its point of division and removal of the clot by direct embolectomy, it is better to expose the femoral and attempt to dislodge the clot by means of a uterine sound or blunt curet, a method which is much more rapid, less shocking, and possible to perform under local anesthesia   It is obvious however, as he states, that the opposite femoral must be exposed and obstructed by a vessel clamp in order that the loosened fragments of the embolus may not descend into the femoral of that side   Following loosening of the embolus an arteriotomy must also be done on this side just above the level of the clamp to let any fragments of the broken up embolus which have come down be worked out by the blood stream   a clamp being placed above to shut the stream off when the clots are cut and so that the arteriotomy wound may be sutured

Attention is called to Key's statement emphasizing the possibility of multiple, emboli and that small emboli which have gone farther down than the main emboli may cause postoperative disturbances   We believe, as has been suggested, that many incisions in vessels are made too short, due to the fear of operators that clotting will occur along the suture line   Too

small incisions result in unnecessary trauma to the vessels in forc ing out the clots resulting in a greater likelihood of clotting as a result of this than from the suture line of an adequate incision

At least one writer[1] on this subject advises that intervention be attempted even in cases where gangrene has set in as thereby an improvement in circulatory conditions may be secured This he writes is proved by 5 cases in the literature

This same author urges that arteriosclerosis is no contra indication at least for an operative exposure of the artery and that if the condition of the arterial wall renders arteriotomy impossible an attempt should be made to crush the embolus after the method of Abadie and Mathelin

While we have had no experience with embolectomy on an artery the wall of which was too sclerotic for operation we have had 1 case in which the embolus was undoubtedly broken up or loosened by digital manipulation

Case I — Mrs E B aged sixty eight years Patient was operated upon four years ago for a toxic goiter She made a splendid recovery following the operation and considered her self well until her present admission when she complained of sharp pain in the right upper quadrant After investigation a diagnosis of cholelithiasis was made Cholecystectomy with choledochostomy was performed During convalescence from the gall bladder operation she had several attacks of pain with fever the pain being in the region of the right kidney The urine was loaded with pus Pyelograms showed a large right hydro nephrosis At operation the right kidney was found to be almost completely destroyed Nephrectomy was done On the morn ing of the tenth day following this operation patient was seized with severe pain in her left thigh which soon extended to include *the whole lower leg A neighboring patient massaged the* thigh vigorously with improvement in the pain in the region of the thigh but patient stated that the pain in the lower leg be came rather more intense Patient was seen shortly after the

[1] Enc M chaelsson E n Fall von Geglückter Embolectom e Acta Ch r urg ca Scand na ca ol 56 1924 p 438

leg had been massaged and there was good pulsation of the femoral artery as felt in Scarpa's triangle. The popliteal artery could not be felt nor could the dorsalis pedis or posterior tibial arteries. The entire foot and lower leg was of a peculiar waxy color, to touch the foot was distinctly less warm than the opposite member. A pin prick of the great toe bled distinctly less than a similar puncture of the opposite foot. The pain in the lower leg was excruciating. One half hour later patient was seen in consultation with Dr Hamilton. The pain by this time had subsided to a considerable degree, other signs still were present. Diagnosis of embolus, probably in a branch of the popliteal artery or one of its branches was made. In view of the fact that the pain seemed to be subsiding and that the embolus was probably low down in the popliteal or in one of its branches, expectant treatment was decided upon.

During the subsequent week the foot continued to be exceedingly painful. There was no pulsation in the popliteal or dorsalis pedis arteries. The foot was cold to touch. The fourth toe became discolored in its distal portion and there was a purplish mottling around the heel. Aside from the foot the lower leg did not show any abnormality. Berger board treatments were started as well as daily treatments with the Quartz lamp. Within three weeks all the discolored area had disappeared. There was no pulsation to be felt in the arteries and the pain continued. During the following month the treatments with the Berger board and quartz lamp were continued with slow but progressive improvement.

At discharge there was no discoloration of the foot whatever and there was a question of pulsation in the dorsalis pedis artery, some observers believing they felt it others not.

Comment —In this case the patient, as far as we know, had no pre-existing heart disorder. Her peripheral vessels showed well marked sclerosis. Her pulse had been regular at all times and there were no signs of congestive failure. Expectant treatment was decided upon because the location of the embolus seemed to be in one of the branches of the popliteal in which case it did not seem practical to attempt an embolectomy

From her history it would seem that the embolus first lodged in the femoral artery and was forced downward into one of the smaller branches of the lower leg by the vigorous massage received at the hands of a neighboring patient

Case II —Mrs E C , aged fifty six years Entered hospital complaining of fatiguability, breathlessness, and orthopnea Symptoms had become progressively more severe for several years There had been no rheumatic infection or significant diseases The heart was enlarged the rate was 140, absolutely irregular There was a suggestion of mitral diastolic murmur The liver edge was palpable but not tender There was slight edema of the extremities The signs of failure largely occurred *forty eight hours after entrance*

Ten days after signs of failure had cleared patient was seized with a sudden sharp pain just above the right knee When seen a few minutes later the whole lower leg was of diminished warmth and wax like in color Just above the knee, extending upward for about 4 inches the skin was of a mottled reddish purple color The femoral artery could be felt pulsating for about 2 cm below Poupart s ligament Below this it could not be felt No pulsation could be felt in the popliteal arteries or in the posterior tibial or dorsalis pedis A diagnosis of embolus in the femoral artery was made and operation begun two and a half hours after the first symptoms had been noted

Operation (Dr Lahey, Dr Mason assistant, Dr Sise, anesthetist) —Under spinal anesthesia an incision 8 cm in length was made in the left thigh over the femoral vessels The femoral artery was exposed from Poupart s ligament downward for about 10 cm There was vigorous pulsation in the upper portion of the exposed artery for about 4 cm below Poupart s ligament Below this point for about 8 cm the vessel was of a cord like consistency and markedly diminished in caliber The profunda femoris was of a like consistency and without pulsation The pulsation of the artery from above caused a distinct downward thrust on the occluded portion A vessel clamp was applied about 1 cm above the point of cessation of pulsation Another

clamp was applied about 1 cm. below the occluded portion. An incision 1 cm. in length was then made in the artery with its upper level just above the point of occlusion. Upon opening the artery at this point the clot extruded. By gentle traction a portion of the clot 2 cm. in length was removed. The point of emergence of the profunda femoris was investigated and its lumen found occluded by a clot. This was also removed by gentle traction. The arteriotomy was then closed by a layer of oiled silk sutures. Before removing the clamps another arteriotomy was done just above the lower clamp. Investigation of the artery at this point showed no clot. The upper clamp was then loosened and blood emerged from the lower incision with a brisk spurt. This was done in order to wash out any remaining small particles of clot. The upper clamp was again tightened and the lower arteriotomy closed in a similar manner as the first. Both clamps were then removed. Immediately following the removal of the clamps there was no pulsation in the artery. Warm saline compresses were applied. Within a very short time pulsation could be distinctly felt throughout the length of the exposed artery. An observer reported a feeble pulsation in popliteal artery, but the color of the foot remained unchanged. After closure of the incision in the thigh the leg was carefully wrapped from toes to groin with cotton.

Diagnosis.—Embolus of the right femoral artery.

Operation.—Embolectomy.

A few hours after operation this patient complained of pain in her right arm. Her hand and forearm became snowy white in color and radial pulse could not be felt. The following day she had a moderate convulsion with evidence of a cerebral embolus. These convulsions recurred several times through the day. She was wildly excited and delirious and there was still no evidence of pulse in the right arm or in her right leg. She became unconscious, failed rapidly, and died suddenly twenty-four hours following operation.

Comment.—This patient undoubtedly had an ulcerative endocarditis with multiple emboli, which apparently continued after operation. Autopsy refused.

Case III—A F aged forty years was admitted to the
Cardiac Service under Dr Hamilton complaining of orthopnea
and breathlessness of several years duration There had been
no rheumatic infections or other significant illnesses in her past
history

Physical examination showed a heart grossly enlarged the
apex was easily felt in the midaxilla the ribs and sternum moved
with the heart beat the apical first sound was loud and long
There was a mitral diastolic murmur The rhythm was regular
except for a slight suggestion of alternation The rate was 120
blood pressure 124/90 There was slight fulness in the region of
the liver though the edge could not be felt There were no
masses or tenderness The patient responded at once to rest and
diet Her orthopnea completely disappeared her lungs had
cleared the liver fulness had gone and the heart rate had be
come slow within twenty four hours

After about ten days the patient suddenly developed an
absolutely irregular heart rate—auricular fibrillation There was
no history of previous attacks The signs of congestive failure
returned at once The liver edge was palpable at least three
fingerbreadths below the costal region and rales in the lungs were
numerous With digitalization the heart rate returned in about
twenty four hours to normal limits with relief of the congestive
failure but the auricular fibrillation returned within the next
twenty four hours and persisted in spite of the continued digi
talis The signs of failure did not return

Two and a half weeks after the signs of congestive failure
had disappeared during the afternoon of the twentieth day in
the hospital patient suddenly complained of a knife-like pain
just above the right knee Within a very few moments she
complained of a similar pain in the left knee On examination
both lower legs were cold to touch and of a waxy like color except
for an area extending upward from the knee for about 3 inches
which was of a mottled purplish color She was able to flex
each knee slightly but this was accompanied by excruciating
pain throughout the legs On both sides the femoral arteries
could be felt pulsating for about two fingerbreadths below

Poupart's ligament The pulsation was somewhat stronger on the left side There was no pulsation felt in the popliteal dorsal pedis, or posterior tibial arteries It was decided that she had a simultaneous occlusion of the femoral arteries probably at the point of origin of the profunda femoris

Operation (Dr Lahey, Dr Mason, assistant, Dr Sise anesthetist) —Incision 10 cm in length in right thigh over femoral vessels Femoral artery exposed from Poupart's ligament downward for a distance of about 10 cm Pulsation was absent below the level of the profunda femoris Vessel clamps were applied well above this level and at the lower end of the exposed artery An incision was then made in the artery about 1 cm above the lower clamp This exposed the clot in the lumen of the artery By milking the artery from above a clot about 4 cm in length was expressed The clamp at the upper end of the artery was then released, but there was no flow of blood Accordingly the clamp was again tightened and incision made in the artery $\frac{1}{2}$ cm below the level of the profunda femoris Here another clot about 1 cm in length, was found This was expressed by milking the artery from above and by extraction with forceps A small catheter was inserted in this incision and injected water emerged freely from the lower incision This indicated that the lumen was free When the upper clamp was released blood spurted freely from both incisions All blood was washed from lumen The incisions in the artery were then closed by fine arterial silk sutures The upper incision was closed first, and with release of the upper clamp blood emerged from the lower incision in a brisk spurt Clamp was again tightened and the lower incision closed in a manner similar to the first All clamps were then released and the pulsations were felt and seen throughout the exposed length of the artery A similar procedure was adopted in the left thigh Here, however, the clot was plainly felt to be about 3 cm below the level of the profunda femoris By means of clamps and two incisions, as described above, the clot, about 4 cm long, was expressed After suture pulsations could be plainly seen and felt throughout the length of the exposed artery Immediately following the operation in each

leg there was a distinct change in color of the feet and lower legs
The color changed from a waxy white to a mottled reddish blue
There was no appreciable warmth of the skin   At the end of the
operation it was thought that there was pulsation in the right
popliteal but none could be felt in the left   The dorsalis pedis
could not be felt on either side   Patient's general condition at
the end of the operation was considered fair

Diagnosis —Bilateral femoral occlusion by emboli

Operation —Bilateral femoral embolectomy

On return from the operating room patient's condition was
considered very good   On the following morning however she
complained of excruciating pain in the lower abdomen and
became greatly distended   From this time on she failed rapidly
and died on the morning of the second day   thirty six hours
after operation

Autopsy revealed a chronic ulcerative endocarditis with
mitral stenosis   There was chronic passive congestion of the
lungs liver and spleen   There were multiple infarcts of spleen
There were multiple thromboses of the mesenteric and splenic
vessels with secondary hemorrhage into the omentum and retro
peritoneal tissues

A careful dissection of the femoral vessels showed that on the
left side complete removal of the embolus had been effected
There was no bleeding above the line of suture   On the right side
the main channel of the artery was clear with no bleeding above
the suture line   However there was an embolus protruding from
the profundus branch

Comment —This case was thought to be a favorable one for
operation because of the definite physical signs and because there
was no clinical evidence of ulcerative endocarditis as the cause of
the emboli   It was thought that a single thrombus had formed
behind the stenosed mitral valve during the auricular fibrillation
and congestive failure and had been the source of the emboli
If this were true the emboli would not have repeated

Case IV —A M aged forty seven years   Entered clinic
complaining of nervousness and loss of weight   She had con

sidered herself well up until six months before admission. Since this time she had lost 20 pounds in weight. She had grown increasingly nervous and irritable, tired easily, and noted tachycardia.

Physical examination showed a fairly well-developed and nourished woman. The thyroid gland showed a symmetric, firm, diffuse enlargement, characteristic of the hyperplastic type. The pulse rate was 144 with a regular rhythm. There was a fine tremor of the extended fingers. A basal metabolism showed a rate of +74. A diagnosis of primary hyperthyroidism was made and operation advised. She was put on a preliminary régime of rest in bed and Lugol's solution, and after eight days her condition had improved to such an extent that it was thought time for operation Careful examination of her heart revealed no abnormality. It was not enlarged and the rate was regular.

During the operation she ran a consistently high pulse rate with high pulse pressure, and it was deemed inadvisable to do a complete operation at that time. Accordingly, a right first-stage hemithyroidectomy was done. The procedure she stood very well and was returned to her room in good condition.

Her initial operative recovery was good. Twenty-four hours after the operation she developed auricular fibrillation which responded promptly to digitalis. On the evening of the third day, sixty hours following operation, the patient complained of a sudden knife-like pain just above the left knee. Within a few minutes the pain had become more diffuse and extended downward to the toes. The left lower leg when seen by the nurse at *that time was blanched*. When seen about fifteen minutes later the toes were wax-like in color and cold. About the ankle was a diffuse reddish blotching. No pulsation could be felt in the dorsalis pedis or in the popliteal arteries Strong pulsation could be felt in the femoral artery just beneath Poupart's ligament. Just below the point of cessation of pulsation there was a distinct pain on pressure over the course of the artery. A diagnosis of embolus of the femoral artery was made. In view of the pulsation of the femoral artery in the vicinity of Poupart's ligament and absence of pulsation in the popliteal artery, it was thought

that the embolus was high up in the femoral probably at the point of origin of the profunda femoris   Operation was decided upon and explained to the patient, who gave her consent   Operation was begun forty five minutes after the diagnosis was made

Operation (Dr Mason, Dr Fife, assistant Miss Weymouth anesthetist)—Under ethylene anesthesia an incision 10 cm in length was made on the anterior surface of the left thigh over the femoral vessels   The femoral artery was exposed for about 2 cm above the profunda and about 6 cm below the profunda   About 3 cm below the profunda pulsation stopped and here there was a distinct downward thrust of the artery resembling that of an artery tied in an amputation stump   The artery was not collapsed but was hard and firm and diminished in caliber   In order to free the artery to apply clamps the dissection was carried a little farther beneath the artery in order that it might be lifted up   After this had been done we were very much surprised to find that the pulsation now extended throughout the length of the exposed artery   The pulsation was felt to extend as far down as the finger could reach   An observer now reported that there was a strong pulsation in the popliteal artery   The blanching of the toes however was unchanged   The conclusion was that the embolus had been dislodged and had become engaged at a lower point   The bifurcation of the popliteal artery seemed to be the most likely place for this to have happened   Patient was turned over on her side and incision made in the popliteal side to expose the bifurcation of the popliteal artery   Here however there was seen no obstruction   It is probable that the embolus lodged in one of the small branches probably in the anterior tibial   The leg was wrapped in cotton and patient returned to the room   She was in fairly good general condition

Diagnosis—Femoral embolus left

The patient made a good initial operative recovery   Her pulse was intermittently irregular and she was given digitalis   The skin of the lower leg and foot continued wax like in color   No pulsation could be felt in the dorsalis pedis or posterior tibial

arteries The thigh and upper part of the leg appeared apparently normal in color and of normal warmth

On the morning of the third day the toes and the anterior surface of the foot over the instep were of a mottled or reddish color The following day her temperature, which had been normal, became elevated It rose to 102 8° F She developed a right side parotitis Her operative wounds were carefully inspected and no evidences of infection found The following day the patient was distinctly less well The middle toe on the left foot was very dark colored and gangrene was obviously beginning During the next twenty four hours her infection failed rapidly She developed a twitching of the right arm with increased reflexes on her whole right side She was irrational She went steadily down hill and died about eight days following the operation The twitching of the arm and confused mental condition possibly represented the occurrence of cerebral emboli In a case of this kind, with no evidence of endocarditis one would not expect multiple emboli

The first patient was doubtless saved an operation by the vigorous attention of her ward mate and while her extremity was saved as a method of treatment of emboli this plan of procedure could hardly be recommended except as a last resort

It is advised that the greatest gentleness be exercised in exposing and handling the vessels and that compresses soaked in 2 per cent citrate solution be packed about the vessel, that all instruments used be rinsed in this solution, and that probes and curets used to remove emboli be smeared with vaselin There is, however, an occasional comment that citrate solution in the wound has caused poor healing and should not be employed pledgets of cotton soaked in salt solution being used instead

The method of suture appears to make little difference provided the basic rules of arterial suture are adhered to, such as gentleness, fine needles, proper suture material, and respect for the vessel intima

Cases are reported in which two rows of sutures were used one for the media and one for the adventitia (two are probably

unnecessary) and cases (a majority) in which but a single row
of sutures were used   Continuous and interrupted sutures have
both been employed   We have had no difficulty in controlling
bleeding from the wound in the vessel using a continuous stitch
of vessel suture material which may be purchased in tubes
The X method used by us to reinforce the single continuous
line of suture is shown but is only an additional precaution
against leakage

Following the introduction of vessel sutures there is a nar
rowing of the vessel at and below the point of sutures   The
application of a sponge soaked in warm salt solution for a few
moments over the vessel permits one to observe and palpate the
arterial impulses being carried through and beyond the level
from which the embolus was removed

If citrate solution has been employed to wash out the vessel
the wound should be irrigated with sterile water and salt solu
tion to obviate the possibility of this solution interfering with
wound healing

The wound is closed tightly and heat continued to the ex
tremity to lessen the effects of prolonged temperature reduction
upon the tissues

MODERN CONCEPTIONS AND MANAGEMENT OF BILIARY TRACT DISEASE

FRANK H LAHEY

THE diagnosis of gall bladder diseases has, up to comparatively recent years, been dependent very largely upon facts which were elicited from the history Indeed, the diagnoses have been almost entirely dependent upon the history of previous attacks, particularly when patients have been seen between attacks Although recent developments in the way of x ray and laboratory measures have proved definite aids in the diagnosis of biliary tract diseases, the history still remains a very important item in the clinical diagnosis of this condition

Attacks of gall stone colic relieved only by hypodermics, with pain referred in a characteristic way serve to make diagnoses comparatively simple When however gall stone colic is not referred characteristically and is not of characteristic severity, then may the diagnosis of this condition become quite uncertain

In this connection one of the most valuable clinical factors associated with gall bladder diseases in our experience, has been residual tenderness over the gall bladder following the disappearance of the pain

Most attacks of gall stone colic have associated with them, whether mild or severe, a certain degree of inflammatory reaction in the form of acute or subacute cholecystitis which persists in the form of tenderness over or about the gall bladder region on deep palpation even when the colic has disappeared

We have considered, therefore, that right upper abdominal pain followed by evident tenderness is very suggestive of gall bladder lesion

The character of the pain in gall bladder lesions, as we have seen it varies from the slightest discomfort up to the severe and excruciating colic requiring large doses of morphin When

66

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tremity to lessen the effects of prolonged temperature reduction
upon the tissues

with infection results in progressive destruction of the tissue of the organs in which they reside

Persistent kidney stones mean progressive destruction of kidney parenchyma Persistent gall stones, except in the occasional cholesterin stone which occurs without infection, means progressive replacement of the muscular walls of the gall bladder by scar tissue until its walls may be entirely composed of fibrous tissue, the contraction of which has repeatedly converted the normal sized gall bladder into one the size of a small peanut

If it is true that gall stones indicate associated infection, then, too, there is usually associated hepatitis pancreatitis, and perigall bladder adhesions all of these potential factors for the production of (1) diminishing liver function, (2) diminishing pancreatic function, (3) interference with pyloric and duodenal function, and (4) possible malignancy

We believe, therefore, that except as stated above, those occasional cases in which cholesterin stones exist without infection, there are few gall stone cases which may be ignored by their host with impunity

The mechanism of the formation of gall stones has practically always been associated with gall bladder infection As proposed by Naunyn, it has been believed that cholesterin was furnished by the disintegration of the gall bladder epithelium or the extrusion of myelin like masses from its walls It is the opinion of Aschoff more recently that it is not the epithelium of the bile passages and the gall bladder that furnish the cholesterin, but principally the liver cells which secrete it, and it is present in the blood without disintegrating in the process Aschoff gives us proof of this premise in the effect of artificial cholesterin feeding on a rabbit A normal rabbit's bile contains practically no cholesterin, but if cholesterin feeding is carried out, so that the cholesterin content of the blood is increased, cholesterin is excreted by the liver into the bile It is held by Aschoff that the cholesterin forming the nuclei of gall stones therefore is not provided by the gall bladder or bile passages itself, but is provided by the precipitation of the cholesterin dissolved in the bile In fact, Dewey has been able by feeding cholesterin to the rabbit,

to bring about so marked an excretion of cholesterin by the liver and bile passages that small cholesterin stones were formed

In Aschoff s lectures on pathology, under the heading "Origin of Gall stones," he has described two types of gall stones (1) "The pure cholesterin gall stone, which may occur without symptoms in a gall bladder with normal walls and may exist in this state for a long period of time and (2) as the result of migration of organisms, or obstruction to the outlet, infection may be superimposed and inflammatory gall stone disease result Under the influence of inflammatory exudate of the mucous membrane, which is rich in calcium, and of the infectious de composition of the bile, there occurs precipitation of pigment, calcium masses around the nucleus of the cholesterin stone, and thus originates the so called combination stone, from a nucleus of pure cholesterin not of inflammatory origin "

It is evident, therefore, that there are in gall bladders two types of stone (1) The silent stone, perhaps occurring for a con siderable period of time without associated inflammation, and (2) superimposed combination stones the result of inflammation

Even though these cholesterin stones may exist without infection, Aschoff himself still does not consider them harmless He states "I have repeatedly pointed out that these stones through occasional impaction, or overreflex influence of the sphincter system of the extra hepatic bile passages, favor infec tion of the latter, especially of the gall bladder, and may become dangerous for the bearer "

The further experiments by Rous and McMaster, proving the concentrating effect of the gall bladder upon its bile, together with those of Aschoff indicate that gall stones are incidental to this process It has been proved at operations that many gall stones originate all at one time, or nearly so, and are the result of precipitation, plus, in certain cases, a combination of calcium and proteins in the presence of infection

Jaundice is often thought of as one of the associated diag nostic features in connection with biliary tract disease   One must recall however, that it occurs in but a very small per centage of cases of gall bladder diseases, and that, again, a very

definite number of cases of common duct stones exist for long periods of time without the appearance of jaundice.

An attack of colicky pain in the right upper quadrant which disappears, and is then followed by jaundice, is suspicious of this condition. Several attacks of pain in the right upper quadrant, each of which is followed by an attack of jaundice, should make one quite certain of the existence of common duct stones, and when an attack of pain in the right upper quadrant is followed by jaundice plus chills, this sequence of events is almost diagnostic of common duct stones with superimposed cholangitis.

The subject of jaundice in recent years has undergone many modifications from the older concepts of its cause and origin. The older ideas as to jaundice were based largely on the conception that jaundice was almost entirely an obstructive process, that the bile was manufactured by the polygonal cells of the liver, and that obstruction, either in the form of malignancy, stones in the ducts, plugs of mucus, or inflammatory exudates, resulted in biliary back pressure and delivery of the bile pigment into the blood-stream.

Due to the work of Aschoff, McNee, and others, particularly Aschoff's description of the reticulo-endothelial system, a considerable modification of this explanation of jaundice has resulted.

It has been demonstrated that there are certain cells of marked phagocytic activity lining the blood sinuses of the bone-marrow, the serous cavities and the so-called "Kupfer" cells lining the venous capillaries of the liver, which have the ability to take up large quantities of cellular débris and hemoglobin, and, in all probability, to convert them into bilirubin. It is believed by Aschoff and his co-workers that the stellate cells of the liver, called the Kupfer cells, convert the hemoglobin into bilirubin, and that it is excreted by the parenchymal cells of the liver rather than that it is manufactured by the parenchymal cells of the liver, as was the previous conception, based on the work of Minkowski and Naunyn. Proof of this conception is evidenced by the experiments of Mann, who demonstrated that bile may still be present in the blood even after removal of the liver. There are numerous experiments to demonstrate the

probable correctness of Aschoff s theory that the actual produc
tion of bile itself is not associated with the liver cells such as
those of Whipple and Hooper in which hemoglobin was delivered
into the circulation when the circulation was so arranged that it
was limited to the head and thorax only and still bile was
developed This explains readily then the jaundice of hema
togenous origin associated with certain splenic diseases It is
further demonstrated by the fact that in blood diseases char
acterized by extensive red corpuscle destruction high bilirubin
content may be demonstrated in the blood stream with no
change in the character of the bile excreted by the liver For
example pernicious anemia except in the stage of improvement
shows a marked increase in bilirubin serum content of the blood
due very probably to the blood destruction associated with this
disease while secondary anemia shows no elevation in the bili
rubin serum content of the blood

Jaundice therefore based upon the conception of its origin
in the reticulo endothelial system may be of three types (1)
The type in which the hemoglobin is converted into bile delivered
by the liver cells into the biliary passages and due to obstruction
in these passages by stones or malignancy is returned in the
vascular circulation to be deposited in the skin as icterus This
is true obstructive jaundice (2) The type in which due to
excessive blood destruction too much bilirubin is formed in the
endothelial system to be wholly secreted by the liver cells but a
considerable part remains circulating in the blood stream This
is hematogenous jaundice (3) Finally the type in which bili
rubin passes through the Kupfer cells but due to toxic injury
to the liver cells it is not secreted by these parenchymal cells
This is toxic jaundice

This new conception of jaundice based upon the passage or
non passage of bilirubin through the Kupfer cells and excretion
by the polygonal cells of the liver has been enlarged upon by
van den Bergh by means of the diazo reaction now known as
the van den Bergh test Without going into the details of the
reaction it appears certain that bilirubin which has passed
through the Kupfer cells is so changed that it gives a different

(immediate or direct) reaction from that circulating in the blood (delayed or indirect reaction) without having passed through the reticulo-endothelial cells of the liver venous capillaries. This same direct reaction on the part of bilirubin which has passed through the Kupfer cells is obtained whether the bilirubin tested for be that from the gall-bladder or whether it be bile in the blood-stream secondary to obstruction of the biliary passages.

In the same way, bilirubin which has not passed through the Kupfer cells, but is hematogenous in origin, due, for example, to the excessive destruction of red cells by the spleen, as already cited in pernicious anemia, gives always a delayed or indirect reaction. One must have in mind, of course, that both conditions are not infrequently combined in the toxic and infective type of jaundice so that a so-called biphasic reaction may occur.

Practically, the van den Bergh test is a method by which a quantitative estimation of bilirubin in the blood may be made, whereby the progress of jaundice may be followed and increases or decreases demonstrated. In the same way latent jaundice may be demonstrated. True hematogenous jaundice may be differentiated from obstructive jaundice by the type of reaction, but as an aid in differentiating the various types of jaundice as relates to obstruction of the large or fine bile passages and interference with the liver cells themselves it is of little value.

Painless and progressive jaundice is nearly always caused by the malignant obstruction of the common or hepatic ducts, due to pressure upon these structures from cancer of the head of the pancreas, of the gall-bladder itself, or the occurrence of carcinoma directly within these structures. In connection with these diseases, provided the obstruction has been in any portion of the common duct, that is, below the point where the cystic duct enters the main bile canal, we have rarely seen Courvoisier's law to be at variance with the findings. Courvoisier's law has proved itself, in our experience, to be a valuable law in a large majority of cases. It is, in the presence of jaundice, a dilated gall-bladder (palpable through the abdominal wall), is indicative of biliary obstruction due to malignancy, while a contracted gall-bladder (this may be determined definitely only

at operation) is indicative of obstruction due to stones Clinically it is at once evident that the positive portion of this law that is the portion which deals with dilatation of the gall bladder is the more valuable and dependable portion since it may be palpated at examination and presents evidence which is of marked weight in arriving at the preoperative diagnosis

In connection with painless and persistent jaundice we wish particularly to stress the possibility of the existence of a common duct stone without colic We have had 1 case of painless and persistent jaundice which when explored presented a common duct stone the removal of which resulted in a complete recovery This has led us to the conviction that exploration in the case of painless and progressive jaundice with this possibility in mind is justifiable In this connection care must be exercised lest exploration be done upon cases of infectious jaundice

It is also our opinion from our experience with cholecystenterostomy that this is distinctly a justifiable operation in the presence of a dilated gall bladder as the union of the gall bladder with the intestinal tract provided the connection between the gall bladder and the hepatic duct is patent results in relief from the almost insufferable jaundice which these patients have endured during the stages of this disease Even though the mortality particularly in the presence of the so called white bile indicating at least partial suspension of liver function is high we still feel that an operation which permits them to die in the absence of intolerable jaundice is worth the risk

Since cholesterin is so constantly present in gall stones since it is so constantly present in bile and since there is an increase in cholesterol in the blood and bile in the later months of pregnancy and since women—and particularly women who have had children—are so prone to have gall stones it is but natural that changes in the cholesterol metabolism should be suspected of being the cause of the frequency of gall stones in women This is the view advanced and supported by the French school notably Chauffard

Cholesterol appears normally in the blood in a percentage of 150 to 200 mg per 100 c c It appears in excess in the bile

after feeding on meat, eggs, and other foods rich in cholesterol. It is increased in pregnancy, diabetes, and in arteriosclerosis.

Chauffard and also Moynihan assert that in most if not all cases of gall-stones the amount of cholesterol in the blood is increased above normal. This is of extreme importance, as if this were true, it would be very valuable in relation to the production of gall-stones, it would be very important as to the avoidance of certain diets rich in cholesterol to prevent the production of gall-stones, and it would be of marked value in the diagnosis of gall-stones.

Unfortunately, conflicting results as to occurrence of cholesterolemia in gall-stones have been obtained by various observers, with the evidence strongly in favor of the finding of normal values of blood cholesterol except in the presence of jaundice, in which case there is an elevation. This fact may possibly, it has been suggested by Campbell, account for the cholesterolemia found in gall-stone cases by Bell in Moynihan's clinic.

But a few cases have been observed in the laboratory at the New England Deaconess Hospital as yet, but in this number no increases have been found.

Chauffard, and Moynihan after him, give all gall-stone patients a diet list in which foods rich in cholesterol are eliminated, such as eggs, stewed and fried foods, sweetbreads, liver, goose, duck, kidney, pork, game, highly spiced food, oily fish, roe, caviar, butter, peas, cabbage, raw vegetables, strong cheeses, and alcoholic beverages.

It is our feeling at the present time, after carefully following the literature on this subject and from the few cases examined in the laboratory of the New England Deaconess Hospital, that the determination of blood cholesterol by a colorimetric method is so often open to variation in results (see reports of Campbell and Hurst) and reports of the findings in blood cholesterol in gall-stones so conflicting, that it is of little or no value as a diagnostic measure in this disease.

The very common association of gall-stones, however, in two of the pathologic states characterized by cholesterolemia, diabetes, and pregnancy, is at least suggestive of a possible relationship.

at operation) is indicative of obstruction due to stones. Clinically it is at once evident that the positive portion of this law that is the portion which deals with dilatation of the gall bladder is the more valuable and dependable portion since it may be palpated at examination and presents evidence which is of marked weight in arriving at the preoperative diagnosis.

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There have been many discussions as to the advantages of cholecystectomy over cholecystoscopy. There are few discussions today as to the reverse condition. If either conception of the origin of gall-stones is true, that they are due either to a concentration of bile in the gall-bladder together with infection, or to the output of cholesterin by the infected walls of the gall-bladder, then nothing short of cholecystectomy insures their possessor against recurrence of his trouble. Cholecystectomy, in our opinion, is the operation to be employed for stones in the gall-bladder and for infection in the gall-bladder except when the conditions in or about the gall-bladder are such that its removal would jeopardize the patient's life, either through the danger of disseminating its infective and virulent contents and producing peritonitis, or when due to obesity or other conditions making the operative risk too great. Under such conditions preliminary drainage with secondary removal is to be employed.

We hesitate even to discuss the question of whether or not drainage should, or should not, be employed following cholecystectomy. It seems to us that the advantages of non-drainage following cholecystectomy are so trivial, compared to the risk attached to this proceeding, that it is not even worth discussing.

Many of the failures in biliary tract surgery are due to persisting common or hepatic duct stones. No operation for gall-stones is complete without wide exposure of the common and hepatic ducts, and incision and exploration of those structures if dilated or presenting any suspicion of harboring stones or infection. Occasionally a dilated common duct will be demonstrated in which no stone will be found, but, on the other hand, rarely will stones exist in the common duct without dilatation of that structure. It should be remembered that often a large part of the common duct is hidden behind the duodenum and that only by mobilization and inward rotation of that structure may the greater portion of the common duct be exposed. On opening the common duct the finding of dark shreds of mucus and débris in the duct is almost certain evidence of the existence of a common duct stone, even though it cannot be palpated. The most common point for stones of this type to

be located is at the ampulla the point where the duct enters the duodenum

When operations must be done upon patients who are jaundiced the liver function test of Rosenthal is of a certain prognostic value in approximating the percentage of liver di ability

Cases with diminished liver function and associated jaundice should have careful preparation for operation first by accurate estimations of the bleeding and coagulation time and preparation by calcium feeding until the time has been lowered as much as possible and second by the preoperative administration of carbohydrates to increase the glycogen reserve in the liver since it has been definitely demonstrated that glycogen reserve and lack of it are very intimately associated with liver protection and liver injury

Following operative procedures in patients with biliary tract disease and diminished liver function particularly when this diminished function is due not only to biliary back pressure but also as the consequence of associated infection resulting in a combination of obstructive and infectious jaundice then the continuous employment of intravenous glucose solutions has been of inestimable value in our hands

Much of the mortality following operations upon jaundiced patients has been similar to the early mortality of prostatic surgery It has frequently been due to a prolonged operative procedure under ether anesthesia (a drug badly borne by the crippled liver) upon an individual possessing but little liver function no liver glucose reserve and an associated toxic nephritis as a result of the jaundice

In such bad risk cases the employment of proper preoperative preparation the maintenance of glycogen reserve the use of local anesthesia plus a preliminary drainage operation by means of gall bladder drainage when possible (and it frequently is not) or by a tube in the common or hepatic duct will make possible the rehabilitation of many of these seemingly hopeless cases just as it has in other somewhat similar situations in surgery

CHOLECYSTECTOMY

Frank H. Lahey

———

The methods of removing gall bladders in various surgeons' hands by the nature of the procedure cannot vary greatly in the main   Gall bladders may be removed from the fundus downward or from the ducts upward   There are however certain procedures in the course of cholecystectomy which in our hands have proved of value in facilitating the removal and added to the security of the procedure

First as to the selection of cases in which gall bladders should be removed from the fundus downward and those in which cholecystectomy should be performed from the ducts upward In this clinic it is the rule that in all cases in which adequate and clear exposure of the junction of the cystic and common duct under direct vision cannot be made the gall bladder shall be removed from the fundus downward   In all cases in which a marked induration and thickening exists about the junction of the common and the cystic duct so that clear definition of the cystic artery cystic duct common duct and their relationship do not exist the gall bladder shall be removed from the fundus downward   All gall bladders possessing such thick and indurated walls that the traction upon the ampulla or pelvis of the gall bladder necessary to expose the ducts would result in possible rupture of that structure and soiling from septic contents are removed from the fundus downward

The type of gall bladder disease in which these three conditions arise most commonly is the rigid thick walled gall bladder of subacute cholecystitis often with a stone lodged at or in the cystic duct so that there is enormous distention of the gall bladder the thickening and induration extending downward and involving the cystic common and hepatic ducts and the

size of the gall-bladder being such that even a glimpse of the ducts and their relationship may not be had.

In such cases it is true that by puncture and evacuation of the gall-bladder it may be possible to so collapse it that exposure of the junction of the common and cystic ducts may be obtained. We prefer, however, to remove the gall-bladder unopened, if possible, which may be done even in those cases in which enor-

Fig 226 —Preparation of peritoneal flaps and removal of gall bladder from the fundus downward

mous dilation has occurred   Fortunately, in the cases of subacute or acute cholecystitis in which this enormous dilation occurs, conditions are most favorable for cholecystectomy from the fundus downward. Many of the small venous channels between the gall-bladder and its bed in the liver have become thrombosed, the wall of the gall-bladder has become so stiff and thickened that peritoneal flaps may easily be made from the walls, and if the fingers be inserted in the proper layer, either at the top or

bottom of the gall-bladder, it readily separates from its bed, leaving behind a pale layer of edematous connective tissue which may later be covered by the peritoneal flaps or packed with a strip of gauze with a piece of rubber-dam laid over it

With the gall-bladder freed from its bed, it now hangs by its cystic duct and cystic artery, which may be exposed by placing

Fig 227 —Introduction of the finger beneath the gall bladder into the line of cleavage separating the fundus of the gall bladder from the liver with acute and subacute cholecystitis in removal of the gall bladder from the fundus downward

a deep retractor over the gall-bladder bed in the liver and retracting it upward. Gentle traction on the gall-bladder now presents the junction of the cystic, common, and hepatic duct seen from behind. By means of a small piece of gauze grasped in the right angle clamps of Lower, and with the aid of a fine and blunt-bladed pair of scissors, the cystic artery may be sepa-

rated from the duct, clamped, and the duct then carefully wiped out until its junction with the common duct is demonstrated, and then cut between clamps and tied

A disadvantage of the fundus to duct removal of the gall-bladder has been that any bleeding encountered, while separating
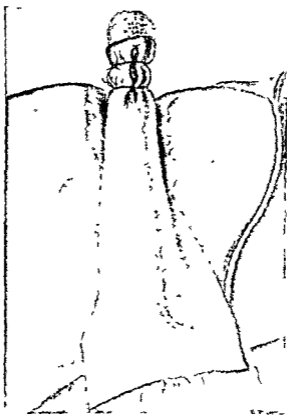

Fig 228—Method of packing defect in liver with gauze and covering gauze with an apron of rubber-dam in acute cholecystitis where peritoneal flaps cannot be made

the fundus from the liver, runs down to later obscure the ducts. A greater amount of drainage is required and there is much more bleeding The actual removal of the gall bladder, in our hands at least, is accomplished with a greater amount of trauma than is the case with duct to fundus removal We have there-

fore felt that it should be confined to those stiff-walled gall-bladders not lending themselves well to removal from ducts to fundus

The removal of the gall-bladder from below upward requires, above everything else, an adequate incision. It is essential also that the incision be extended upward as high as possible, since

Fig 229 —Semidiagrammatic illustration of the gall bladder entirely separate from its liver attachment Note Illustration should show cystic artery caught and cut between clamps and ligated first and separately, the gall bladder then being suspended solely by the cystic duct

eversion of the liver edge with its attached gall bladder is often not possible with a low incision.

The next step in the procedure is to grasp the fundus of the gall-bladder with a short right angle clamp and make gentle traction upon it Another right angle clamp then grasps the dilatation of the gall bladder at its lowest portion, often spoken

of as the pelvis of the gall bladder and a thick warm wet strip
is laid longitudinally along the duodenum and a long bladed
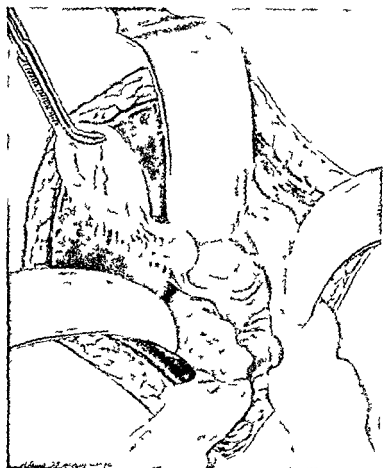Deaver retractor placed over the gauze   Traction then on the

F g 230 —Tract on on gall bladder introduct on of gauze pads and
countertract on on the duodenum   Note Gauze pads introduced into the
k dney pouch up to the foramen of W'nslow (hour glass gall bladder)

pelvis of the gall bladder through the attached cystic duct pulls
that structure and the common duct in one direction and dis
location of the duodenum by the gauze pad and Deaver retractor
in the opposite direction place the cystic and common ducts so

upon the stretch that they are at once made prominent and much more easily dealt with than when resting lax at the very bottom of a deep hole.

An incision with a sharp knife is then made through the peritoneum over the common duct close to the duodenum and carried up to the point where the common and cystic ducts join. The incision is divided here, one going to the right and one to
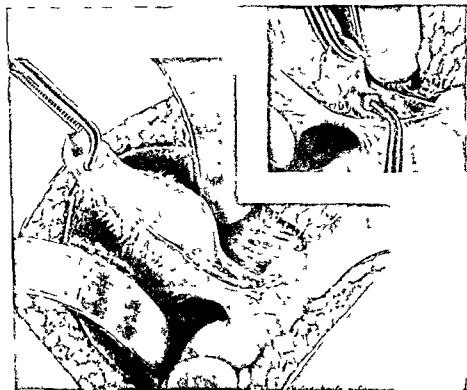

Fig 231 —Showing the peritoneum incised, as described, over the common duct, cystic duct, and gall bladder to make peritoneal flaps Insert shows pelvis of the gall bladder grasped, lifted, and the cystic duct being wiped out as described

the left up over the gall-bladder and penetrating only the peritoneum over it. The incisions are carried to the fundus of the gall-bladder and small wads of gauze in the jaws of right-angled clamps wipe back the peritoneal flaps and expose the junction of the cystic and common ducts and the cystic artery. The cystic artery is separated from the duct and the duct and artery clamped and tied separately.

of as the pelvis of the gall bladder and a thick warm wet strip is laid longitudinally along the duodenum and a long bladed Deaver retractor placed over the gauze Traction then on the
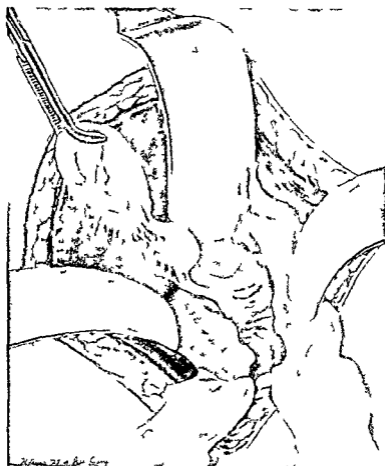

Fig 230—Traction on on gall bladder introduction of of gauze pads and countertraction on on the duodenum Note Gauze pads introduced into the kidney pouch up to the foramen of Winslow (hour glass gall bladder)

pelvis of the gall bladder through the attached cystic duct pulls that structure and the common duct in one direction and dislocation of the duodenum by the gauze pad and Deaver retractor in the opposite direction place the cystic and common ducts so

cystic duct and artery is done step by step as more and more of the gall-bladder is dissected by blunt scissors from its bed, together with gentle traction on the proximal end of the cystic duct. The peritoneal flaps having been sutured from the duodenum to the upper portion of the defect in the lower made by the removal of the gall-bladder, the operation is completed.

FIG 233 —Suture of the peritoneal flaps over the common duct, the cystic duct, and the bed of the gall-bladder.

Should it become necessary to explore the common duct, it will not be found difficult with that structure put upon the stretch, as we have described above, to wipe out the duct with the small wad of gauze in the right-angled clamp, as in the case of the cystic duct and artery. The common duct may be recognized by the network of vessels on its wall described by Homans, and not present over the cystic duct. It may be con-

vincingly demonstrated as the common duct by plainly wiping
out the point of entrance of the cystic duct into it

It should be recalled that often more than half of the com
mon duct lies behind the duodenum and is not exposed by the
ordinary methods of demonstrating the common duct   For the
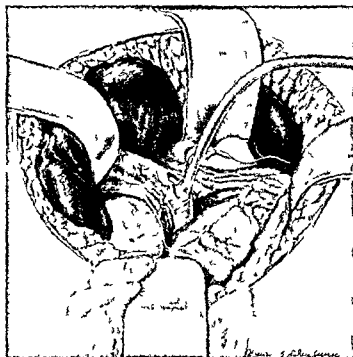exposure of that portion the retroduodenal portion of the duct,

Fig 274 —Incision of the parietal peritoneum beside the duodenum and
mobilization of the duodenum by inward rotation to demonstrate the retro-
peritoneal portion of the common duct   Introduction of T tube for drain
age   No ligature of small vessels running over the duodenum in the parietal
peritoneum

an incision should be made in the parietal peritoneum just
external to the duodenum   Numerous small vessels will be
found here in the parietal peritoneum to run transversely across
and over the duodenum   Bleeding from these small vessels
will be found extremely troublesome unless they are ligated
and cut between ligatures   With incision of the parietal peri

oneum the duodenum may be wiped gently inward, rotated, and the retroduodenal portion of the duct exposed either down to the part where it enters the posterior wall of the duodenum or, as is often the case, down to the part where it passes through pancreatic tissue.

We believe that this exposure of the retroduodenal portion of the common duct in doubtful cases is of distinct value, as it is in this portion of the duct, close to the ampulla of Vater, that stones are most commonly overlooked.

Incisions made high in the duct close to the cystic duct do not permit of easy investigation of the ampulla region with stone forceps. Where stones exist in the common duct close to the cystic, an incision may be made directly over the stones for easy removal Where, however, only a dilated duct is encountered and no stone may be felt, as is sometimes the case, with but a single small stone at the ampulla, the rotation of the duodenum with exposure of the retroperitoneal duct with incision in the duct as low as possible often facilitates the discovery and removal of a stone which may be discovered only by the exploring stone forceps within the duct

Rarely will stones be absent from ducts which are dilated and from which escape strings of mucus or detritus darker than the bile in which they float.

HYPERTHYROIDISM PERSISTING AFTER THYROIDECTOMY. THE NECESSITY FOR POSTOPERATIVE EXAMINATIONS IN TOXIC GOITERS

Howard M Clute

It has been the custom in this clinic for many years to examine all patients who have been operated for hyperthyroidism at stated intervals after the thyroidectomy. The routine which we follow, as closely as the circumstances will permit, is to ask the patient to return once every two months for the first six months after operation for metabolic and clinical examination. A final test and examination is made one year after the operation This system of postoperative care has been of the greatest value to these patients

Whatever may be the basic cause of primary hyperthyroidism, it is a fact that removal of a large portion of the thyroid gland cures the disease in the vast majority of cases Just how much thyroid substance must be removed in any individual case to produce a cure can be determined only by long experience A small amount of very hyperplastic tissue will be sufficient to maintain a normal metabolic rate in one patient In another case there may be present well-marked involution of the thyroid tissue which will make it necessary to leave a larger section to maintain a normal gland function The final decision in all patients must rest with the judgment of the individual operator based on his previous experience with similar cases

These things being true, it is not remarkable that after thyroidectomy in certain cases there will be more thyroid tissue left than is desirable, and that in certain other cases insufficient thyroid tissue will remain The presence of either of these possibilities can only be known by repeated postoperative examinations of each patient

The basal metabolic rate follows very closely the clinical improvement after thyroidectomy It is generally normal within two months if sufficient thyroid tissue has been removed from the neck Occasionally, however, the rate does not reach normal until four or even six months have passed after the operation, although the clinical improvement in this interval may be relatively great We have long believed that a persisting high metabolic rate in primary hyperthyroidism after operation indi cated that there was insufficient removal of thyroid tissue

Examination of the neck months after a partial thyroid ectomy is often difficult The anterior face of each thyroid lobe having been removed at operation, the remaining segments will be but little anterior to the level of the cricoid cartilage and trachea Furthermore the numerous adhesions which are present between the precervical muscles and the thyroid rem nants and the scar tissue formation throughout the operative field render accurate palpation of the area impossible without a definite plan of procedure Such a plan was recently described by Dr F H Lahey [1] By this method the patient's head is first turned toward the side to be examined and the chin slightly raised from the horizontal The larynx and cricoid cartilages, together with the thyroid remnants, are now pushed by the non examining hand toward the side of the neck which is to be pal pated To examine the lobe the thumb is placed over it in front of the sternomastoid muscle and the fingers well behind this muscle The patient is now requested to swallow, and the thyroid lobe will be felt to move up and down between the physician s thumb and fingers inside the sternomastoid muscle Many details of the gland can be obtained by this method which would otherwise not be apparent and large remnants of thyroid tissue may often be felt It is our experience, however, that after thyroidectomy for primary hyperthyroidism good sized pieces of thyroid tissue will be present in the neck in every patient who has an elevated metabolic rate and clinical evidence of thyroid toxicity even though they may not be palpable before operation

[1] Method of Palpating the Lobes of the Thyroid by Dr Frank H Lahey, to be published in Amer Jour Med Assoc

From a recent study of 48 patients on whom secondary opera tions for hyperthyroidism had been done in this clinic, we are convinced that the term "recurrent hyperthyroidism," as gen erally used, implies that the toxic process was completely abated following operation and then after some little interval of health once more returned   To only 5 of the 48 cases in which we have complete records could the term "recurrent hyperthyroidism" be applied   In these 5 patients there existed an interval, aver aging two years in which they were clinically cured and showed at some time a normal metabolic rate before there was any return of their symptoms of hyperthyroidism   Such cases in our opinion, can truly be classed as "recurrent"   In 19 patients whose records are complete it is evident that at no time were they wholly free from evidence of hyperthyroidism after their first subtotal thyroidectomy   Furthermore, in 24 cases whose records are incomplete we have sufficient evidence in many to warrant the belief that their initial operations never brought any period of complete relief from thyroid toxicity, though some improvement often occurred   For this type of patient we apply the term ' persistent hyperthyroidism "

The duration of the thyroidism after the first operation and before the secondary removal of thyroid tissue in these patients varied from three months to fourteen years   In every case at the time of the secondary operation a large sized piece of hyper plastic thyroid tissue was found and removed   In many cases who had been operated upon before the necessity of removing the greater part of each lobe and the isthmus was recognized entire lobes of hyperplastic tissue were present   In 4 cases of the 48 a third subtotal thyroidectomy has been done because of persisting hyperthyroidism   Here as in the other patients, large sized sections of hyperplastic thyroid gland were present

In this group of 48 patients in whom secondary operations for persistent or recurrent hyperthyroidism have been neces sary, 35 are apparently well   They show neither clinical nor metabolic evidence of persisting toxicity to any marked degree Nine patients are not yet traced and 4 patients are still defi nitely toxic   There were no deaths, no cases of postoperative tetany, and no postoperative hemorrhages in the group

In 4 patients there apparently occurred a marked hyper
trophy of the small remnants of thyroid tissue left at the first
operation so that very large pieces were found at the second
operation   One patient in particular has had three subtotal
thyroidectomies   At each of these a large piece of thyroid was
removed from each side of the neck   This woman is still toxic
and a well marked enlargement of the left lobe is again becoming
evident   She has taken Lugol s solution regularly for over a
year without improvement

Lugol s solution has been given repeatedly to these patients
with recurrent or persistent hyperthyroidism in many cases for
periods of a year or more   Usually the metabolic rate has come
to normal and the clinical improvement has been marked fol
lowing its use   In no case that we have followed however has
this improvement been permanent unless there was a further
removal of thyroid tissue   Lugol s solution has not cured
recurrent hyperthyroidism or persistent hyperthyroidism in our
experience   Its value in these cases is apparently similar to its
value in primary hyperthyroidism where it should be used only
as a measure preparatory to thyroidectomy

It has therefore become apparent in this clinic that all
cases of primary hyperthyroidism must be seen repeatedly
during the first year after thyroidectomy for the purpose of
having both clinical and metabolic examinations   In 95 per
cent at least of all these cases both clinical and metabolic
evidence of cure will be present in either two or four months
after operation and usually much earlier   The presence of
clinical evidence of persisting hyperthyroidism and an elevated
basal metabolic rate four months after operation however
generally means that too large a piece of hyperplastic thyroid
tissue is still present in the individual patient under considera
tion   Lugol s solution may be given but only with the recogni
tion that any improvement in symptoms that may follow is but
temporary   In our opinion hyperthyroidism persisting six
months after operation is a positive indication for further
removal of thyroid tissue

THE SCHEME OF MANAGEMENT OF GASTRIC AND DUODENAL ULCER IN THIS CLINIC

Frank H. Lahey

The methods of treating gastric and duodenal ulcer have up to the present been quite sharply divided into the medical and surgical with ardent advocates of each frequently denying the need or value of one or the other methods of treatment. Discussions have waxed warm and at times bitter. The advocates of medical treatment have stated that after the surgeons have operated upon the gastric and duodenal ulcer cases they have discharged them without treatment and the patients have come to them for final cure under medical treatment. The surgeons have stated that a great number of the ulcer cases operated upon by them have already had medical cures in varying numbers. A joint meeting of the medical and surgical sections of the American Medical Association on gastric and duodenal ulcers held at St Louis in 1923, resulted in no approach to any unanimity of opinion, and prompted one of the discussors to remark that the most marked impression he received from the discussion was that it would have furnished excellent material for a Christian Scientist, were there one in the audience.

It is today a demonstrated fact, we believe, that this lack of agreement is largely due to a lack of familiarity of each partisan with the others methods successes and failures. Those who strongly advocate surgical treatment especially in gastric ulcer, have often felt particularly justified in this course by the incorrectly estimated and assumed danger of high percentages of malignant degeneration in gastric ulcer. On the other hand, surgeons have often, in our opinion been justified in stating that many of the cases upon which they operated had had several medical cures with a return of symptoms due in many instances to attempts on the part of gastro enterologists to

handle such patients medically while up and about, often upon an inadequate plan of medical management and without sufficiently impressing or authoritatively persuading the patient to the necessity of adhering accurately to the scheme of treatment

A review of the situation a few years ago left us with certain very distinct impressions which will be set down here, one of which was that some headway might be made, at least for this clinic were it possible to associate a gastro enterologist working directly under a surgeon's vision, demonstrating regularly to us success or failure in the management of gastric and duodenal ulcer of various types in various locations, and with various complications

We were led to the development of this arrangement following a review of our own surgical results with gastric and duodenal ulcer and following a general review of the medical and surgical situation in this field

As regards the surgical situation first, there are two types of surgical procedure—conservative and radical   Under conservative come gastro enterostomy, pyloroplasty, and local excision of small ulcers, the representative operation of this group being gastro enterostomy   Under radical surgery come pylorectomy and partial gastrectomy   Of the conservative surgical measures as represented by gastro enterostomy, there must be admitted a mortality varying from 1 to 2 per cent a failure to cure of approximately 10 per cent in duodenal ulcer and a much higher percentage in gastric ulcer, and an incidence of jejunal or gastrojejunal ulcer very conservatively estimated at 5 per cent We know of nothing which reflects more justifiable criticism against gastric surgery today in general than the conflicting reports as to the curative value of gastro enterostomy and the incidence of jejunal and gastrojejunal ulcer

Of the radical procedures, pylorectomy and partial gastrectomy will show a mortality, in most surgeon's hands, ranging from 10 per cent upward Of the remainder, however, practically all will be cured and will remain so, particularly in partial gastrectomy involving the removal of the acid bearing portion of the stomach

The medical situation as yet cannot be put down in such certain terms There can be little question that cure without operation occurs as we surgeons repeatedly see duodenal and, less oft gastric ulcer scars, which show that healing has taken place As to what the percentage of persisting cures and what the percentage of recurrences are we have no available figures yet

With the above stated fact in mind, two years ago we estab lished in this clinic (which is primarily surgical) the following plan of procedure, and for the accompanying reasons

That the diagnosis of gastric or duodenal ulcer should first be definitely based upon adequate data accurate history, gastric analyses effect of aspiration, alkalies, and albuminous food upon the typical distress, examinations of stools for occult blood, and fluoroscopic and x ray plate evidence of the ulcer

That diagnoses of suspected ulcer cases be grouped under the following heads definite ulcer, doubtful ulcer, and no ulcer

These two paragraphs are set down because there are two tendencies today which do much to upset the value of results in the non operative treatment of gastric and duodenal ulcer There is a distinct tendency to assume that every case with a history at all characteristic of ulcer with an associated gastric or duodenal defect by x ray is an ulcer, to treat it as such and to assess the value of the treatment of this group together with the proved group

Next we have stated that all gastric and duodenal ulcers coming to the clinic, unless possessing definite indications for surgery, and these will be set down later, shall go to bed upon the neutralization regime as devised by Sippy, for three to four weeks and that surgery be or be not undertaken upon these cases based upon their course, progress, and evidence obtained while under this plan of management

We have employed the Sippy plan of management with its half hour feeding of alternating milk and cream and alkalies for neutralization of hydrochloric acid, and with its careful check by stool examination, biweekly gastric analyses and frequent fluoroscopic examination to determine the healing of the ulcer Because the method, based upon the assumption that healing

of the ulcer is best permitted in the absence of unneutralized
acid seems to us the most logical one and because it permits one
to determine from time to time whether or not the basic prin
ciple (neutralization) is being attained, and because it has in
our hands produced immediate and persisting relief of symp
toms in most of the cases with laboratory evidence of healing

Our reasons for employing medical treatment in all cases
without surgical indications are primarily because up to the
present it has brought about a persisting relief of symptoms
with disappearance of blood and disappearance of the x ray
picture of the condition in the gastric cases and improvement
in the x ray defect in duodenal cases Furthermore, we believe
that it is not justifiable to employ conservative surgery with its
1 to 2 per cent mortality, its incidence of at least 5 per cent
gastrojejunal or jejunal ulcer and its failure to cure in 10 per
cent of the duodenal and in a greater percentage of gastric
cases, or radical surgery, as represented by pylorectomy, or,
better, partial gastrectomy with its average 10 per cent mor
tality, until all the possibilities of the conservative methods of
treatment as represented by adequate medical management
have been exhausted

We have insisted upon the hospitalization of the cases while
under this management not only for the beneficial effects of
the rest with partial healing of the ulcer, but because we believe
that some of the failures of the medical treatment of ulcer are
due to the fact that strict adherence to ulcer management is
rarely maintained by the ambulant individual until he has
been trained by hospital regimen This adherence to the plan
of treatment is furthered also by a return to the clinic every
two months for gastric analysis x ray check up of the gastric or
duodenal defect and a critical investigation of the permanency
of the relief and adherence to the plan

The cases considered unsuitable for non surgical treatment
are those with any question of malignancy those of course, with
perforation those in which symptoms cannot be relieved in
seven days those in which occult blood cannot be made to
disappear from the stools in fourteen days (eliminating blood

from other sources), and pyloric stenoses In respect to the
latter, I must admit that under the medical management of the
gastro-enterologist to the clinic, Dr Sara M Jordan, cases of
pyloric stenosis have reopened, remained opened, and been
relieved of the obstruction and ulcer symptoms These are
cases upon which we would have unhesitatingly and immedi
ately performed a gastro-enterostomy previous to my personal
contact and observation of this form of medical management
These cases alone, even without further evidence, would have
demonstrated to us the real enlightenment which may be ob
tained by co operative observation of divergent methods of
treatment Lack of this has retarded and still retards, the
clarification of several situations in medicine to the detriment of
the patient

Carcinoma is readily diagnosed, of course, in those typical
cases with characteristic findings It is, however in the border
line cases those in which free acid is still present and in which
x ray evidence is unconvincing, that helpful information may be
obtained from noting the effect of neutralization and manage
ment

In those cases of gastric ulcer in which the character of the
x ray defect is not definitely improved following a week or
two of treatment under the plan described above, particularly
where occult blood persists in the stools, though there be no
change in the gastric acidity carcinoma is to be suspected and
radical operation is justifiable

Without this evidence exploratory operation is of little
value, since most of those cases with typical gastric carcinoma
show quite convincing evidence by x ray, stool, and gastric
analyses previous to the operation, and are, therefore, not sub
mitted to preoperative management In these borderline cases
however little in the way of convincing preoperative evidence
such as characteristic x ray, absence of hydrochloric acid, etc ,
is consistently present In such cases and we wish particularly
to emphasize this point, exploratory operation often reveals a
small deep ulcer which, however possesses no features dis
tinguishing it as certainly carcinomatous or non carcinomatous

The surgeon therefore is placed in a situation which is most unsatisfactory and perplexing if he subscribes to the views laid down in this discussion first that the percentage of malignant degeneration in gastric ulcers is not sufficiently high to justify resection of all such lesions for this reason alone and second that under proper medical management and co-operation of the patient such ulcers may be healed

If of course one feels that the danger of malignancy is great and the likelihood of cure by non surgical measures slight then he may readily justify the risk of subtotal gastrectomy even when exposure of the ulcer reveals no frank evidence of the presence of carcinoma

But he who believes less in the inevitable malignant degen eration of gastric ulcers and more in the possibilities of medical cures finds himself confronted by a lesion which is either ulcer or malignancy He must either close and watch the progress of the lesion with the possibility of leaving behind a carcinoma or submit the patient to the mortality risk of partial gastrectomy in spite of his conviction that should the lesion prove an ulcer it possessed definite possibilities of medical cure without the attendant risk attached to the surgical method In such cases then as we have emphasized above in cases of gastric ulcer with suspicious but not characteristic evidence of malignancy infor mation of real value in determining the need and justification of partial gastrectomy may be obtained during the progress of medical treatment and this within a period of two weeks a time not too long when one considers the value of the information which may be obtained

This information consists in demonstrating the effects of medical treatment If ulcer relief of symptoms disappearance of blood and improvement in the x ray picture If the condition be malignant no change either in symptoms or x ray picture will occur

When medical management has failed and surgery in duo denal pyloric or prepyloric ulcer must then be accepted we admit to a state of mind at present that is far from one of firm conviction Reports as to the incidence of gastrojejunal ulcer

being so convincing together with the fact that more careful follow up of our operated cases has shown an increasing number of gastrojejunal ulcers, does not permit us to accept the more conservative procedure of gastro-enterostomy so complacently as the procedure of choice in the lesion as we have in the past. Nor do we any more complacently view the procedure of partial gastrectomy with its 10 per cent plus mortality for duodenal or pyloric ulcer as advocated by the opponents of gastro-enterostomy

Partial gastrectomy must of course be undertaken regardless of the risk in reasonable, in the frank cases of gastric carcinoma if the case be operable. The decision to perform this operation for a benign lesion however such as ulcer should be reached only after a careful contemplation of the entire situation the readiness of approach and ease of mobilization of the pylorus and portion of the stomach to be removed with due consideration of the fact that the removal is often the easiest part and the subsequent anastomosis between the bowel and stomach most difficult, the length of time probably necessary to do the operation with allowance for the fact that it is frequently longer than anticipated the possible effect of the aftercare shock and finally the facility and experience of the individual undertaking the procedure. With such facts in mind we urge that where any marked degree of doubt exists as relates to any of these factors a conservative gastro-enterostomy, even with considerable risk of gastrojejunal ulcer be done which always permits of later removal under more favorable conditions upon a better risk patient and with a considerable part of the operation already done

ETHYLENE USES AND PRECAUTIONS

Lincoln F. Sise

ETHYLENE has been used by us since December 1924, and at the present time considerably over half our cases are being done either in whole or in part under this anesthetic Nitrous oxid has been almost discontinued We are now using ethylene

1 Where deep relaxation is not necessary and where the fields of the anesthetist and the surgeon are not too close together This means that it is used in practically all operations except those on the abdomen or the head The largest and most important single group of operations consists of those upon the thyroid gland In these operations it has become the routine anesthetic

2 In many abdominal operations where ether is contra indicated Ethylene does not appear to be the anesthetic of choice for abdominal operations Under full ether anesthesia relaxation is very much better and the operation can be done more quickly and surely and practically without limitation on account of the anesthetic While ethylene is not, therefore the anesthetic of choice, nevertheless, where there are lung or kidney complications, severe diabetes, or weakness from old age or disease, ethylene is the safer and better of the two anesthetics even for an abdominal operation

3 In the course of abdominal operations under ether, where the patient begins to show signs of approaching shock This may or may not have been anticipated as a possibility before the operation In either event the change to ethylene is usually followed by a distinct improvement and the patient's condition is maintained better than under full ether anesthesia Ethylene is continued during that part of the operation where deep re

laxation is not necessary   For closure, ethylene may be con
tinued ether may be added to it, or a shift may be made back
again to full ether anesthesia depending on the condition of the
patient

We have taken up the use of ethylene in preference to nitrous
oxid for the following reasons

1 It is possible to use more oxygen with ethylene than it is
with nitrous oxid This is the chief and outstanding advantage
of ethylene Under it usually from 10 to 20 per cent of oxygen
may be used where under nitrous oxid we can seldom use more
than 10 per cent Thus under ethylene there is a wider margin
of anesthesia before asphyxia is reached   Under nitrous oxid
this margin of anesthesia is sometimes very narrow and occa
sionally so narrow as to reach almost to the vanishing point
Thus we may say that under ethylene the margin of safety is
wider It is safer especially for the weak those in poor general
condition for cardiac cases and for those who are especially
resistant to gas anesthetics There is less anoxemia with eth
ylene Under nitrous oxid there is always with every anes
thesia at least a certain amount of anoxemia While there is
usually probably some under ethylene it is certainly less than
with nitrous oxid and may even sometimes be absent entirely

2 Respiration is notably quieter under ethylene It is less
rapid and less deep It is possible that this phenomenon is a
corollary of the increased amount of oxygen possible What
ever its cause this quiet respiration is of advantage with patients
having lung involvement and probably also with those having
thyroid toxicity

3 There is more relaxation than is obtained with nitrous
oxid though of course the relaxation is not to be compared
with that obtained with ether Nevertheless ethylene is much
to be preferred to nitrous oxid in abdominal operations where
ether cannot be used   It is also possible under ethylene to
operate on the patient in stirrups while this is quite difficult
to accomplish under nitrous oxid Ethylene is quite valuable
for bimanual examination of the pelvic contents   Hemorrhoids
should not be done under it if the operation is with a cautery

4. Analgesia is apparently greater under ethylene than under nitrous oxid. Patients may be run in a slightly lighter plane of anesthesia, and their reflex to operation is less.

Quietness of respiration was mentioned above as an advantage. This quietness is but a form of depression of respiration, and this depression is more marked with ethylene than it is with nitrous oxid. With ethylene it may become very pronounced, especially where much preliminary drugging has been employed. With thyroid patients we usually give a comparatively large amount of preliminary drugging in order to lessen preoperative apprehension. With such patients there is frequently a marked depression of respiration, especially during induction. At this time the depression may be so great as to render it difficult or impossible to secure in a reasonable length of time sufficient depth of anesthesia to start the operation. We therefore use as a routine during induction in all cases where much preliminary drugging has been employed, except severe cases of hyperthyroidism, carbon dioxid to stimulate respiration. Induction is thus quickened decidedly, and the period of depression is entirely eliminated. When induction has been completed the flow of gases may be cut down and respiration stimulated by rebreathing. Carbon dioxid may be of value at any time during an inhalation anesthesia. It will stimulate respiration if this becomes depressed. If the patient becomes too light it will force him to breathe in the anesthetic, so that he can be put under more quickly; and if he becomes too deep, it will help him to exhale the anesthetic, so that he can be brought out from depth more quickly. With ethylene (and to some extent with nitrous oxid) its use sometimes enables us to obtain greater depth with equal safety, for the stimulation of depressed respiration enables us to use a stronger mixture and still keep the patient sufficiently oxygenated.

Carbon dioxid has a stimulating effect on both respiration and circulation. This is undesirable in cases of hyperthyroidism, as these cases are already overstimulated by their disease. In cases of hyperthyroidism, therefore, we avoid carbon dioxid. To do this we use a large flow of gas and a minimum of re-

breathing   In most cases we use a small amount of carbon dioxid for a short time during induction only and in the more severe cases we avoid it entirely unless there is considerable depression of respiration during induction   But for the rest of the anesthesia we use a rather large flow of gas without any carbon dioxid This procedure gives an extremely quiet respiration and stimulates the patient as little as possible

Freezing of the valves during the administration of ethylene may be quite troublesome   It is almost certain to take place unless some provision is made against it   It is due to the rapid expansion of the gas at the control or reducing valve from the high pressure within the tank to that of the atmosphere or near it

The tendency is lessened if the flow of gas is small   The safest heating device to use on the machine is a hot water bag We have here worked out a scheme by means of which the tanks of ethylene are used in such a way that no heating device whatever is necessary   This scheme depends on the fact that ethylene within the tanks at ordinary room temperature is in the form of a compressed gas and not in the form of a liquid as is nitrous oxid   Thus the pressure within the tank goes down exactly in proportion to the amount of gas which is used from it   With nitrous oxid there is practically no lowering of pressure until the liquid has all been used and there is only the gas left within the tank.   When the ethylene tank has been about half emptied the pressure within it has been so lowered that freezing will no longer take place at the control valve   We therefore use ethylene from two tanks at the same time one of which is at least half empty   If for instance we start with tank   A' half full and tank B entirely full we use from tank 'B' as much as possible up to about half the total amount   The balance is used from tank ' A and all the adjustments are made from this tank   If at any time we need a large flow of gas we can get it from tank "A, though it would not be possible to get it from tank ' B ', but by the time that tank A is empty tank "B" is approximately half empty, and is shifted to the position of the original 'A' tank, while a new tank is put in in place of tank "B " Thus, by distributing the production of cold

between the two tanks and by having one tank always at least half empty, we can always get the desired flow of ethylene without danger of the gas shutting off through freezing at the valve.

In working with ethylene its inflammability must always be borne in mind. This feature of ethylene is the outstanding objection to its use. A knowledge of the precautions necessary in order to avoid trouble from this feature is so important that it will be discussed even at the risk of repeating much that has already been said.

Ethylene "is inflammable, and when mixed with certain amounts of oxygen or air is highly explosive. Mixtures with oxygen must have a maximum of about 60 per cent. ethylene to be explosive, and the greatest violence of explosion comes with about 25 per cent. ethylene. With air 5 to 10 per cent. ethylene is explosive. Richer mixtures than these can be ignited, but do not explode. Leaner mixtures cannot be ignited, nor do they explode. A mixture of ethylene and oxygen, if subjected to high pressure such as occurs within the tanks, may explode spontaneously."[1]

The mixtures most commonly used during anesthesia run from about 75 to about 90 per cent. ethylene. They are, therefore, too rich to explode. Occasionally, however, for short periods and in a very few instances, perhaps continuously, a mixture may be used which is weak enough to fall within the limits of explosibility. The mixtures commonly used, while too rich to explode, are still inflammable and may catch fire just as ether may. It seems probable, however, that they may "catch fire more easily than ether because they remain inflammable at a greater distance from the mask. The ether mixture is near the lower limit of explosibility. Consequently it takes very little dilution with air to weaken it beyond the point at which it will ignite. Moreover, ether vapor is about two and one-half times heavier than air and tends to drop to the floor out of the way. The ethylene mixture is too rich to explode. Therefore, as it drifts away from the mask and is diluted with air, it becomes explosive

[1] Sise, Boston Med. and Surg. Jour., 192, 7, p. 287, February 12, 1925.

at a distance where ether would perhaps have become too weak to ignite, and then this explosive mixture has to be diluted still further before it will be too weak to ignite Consequently it seems probable that it will catch fire at a greater distance from the mask than will ether Moreover, it is of almost the same weight as air and so may drift in any direction

"There seems no danger that a room could get so full of ethylene that its contents would form an explosive mixture and the whole room be exploded *en masse*

' All possible sources of ignition should be kept out of the operating room There is a wide variety of such sources, chiefly the cautery and sparking electrical apparatus such as fulguration apparatus *x* ray, or ventilating fans Electric currents, particularly of high amperage such as those used with heaters, should not be switched off If they *must* be switched off, care should be taken to see that any possible drift of ethylene toward them is broken by making a current of air across the drift

' The most elusive form of ignition is the static spark That the danger from this source is by no means imaginary is shown by several recorded instances Ethylene gas flowing over insulating material such as rubber so commonly used in the leads from gas machines, may form a static charge One may be formed by the motions of a breathing bag and especially by the motion of the bag against an enclosing fabric netting

"To guard against these various sources insulating material should be avoided, and machine table patient and anesthetist should be connected together by an electric conductor The rubber leads from the machine should be replaced by metal, or at least a wire preferably spiral should be run down the inside of the rubber tube For the small tubes the flexible metal tubes used for gas appliances are excellent The machine, table, and patient may be connected together by copper wire " and all may be grounded by running a metallic connection to some suitable ground "The anesthetist should then take hold of some part of this group before turning on the ethylene and so ground himself to the same potential Metal masks should be used instead of celluloid, as, in the event of the ethylene catching

fire, it seems probable that the patient may receive a worse burn from the explosion of the celluloid than from the ethylene"[1]

The breathing bag sometimes offers a problem Where the bag is close to the patient, the inside is probably sufficiently moistened by the patient's breath to cause any static charges to leak off If the bag is at a distance from the patient, a fine chain should be run through it and soldered to the nearest metal parts Where it separates two metal parts, these should be connected together carefully by wire or small metal chain Fabric netting around the bag should be replaced by electrically conductive netting carefully connected to neighboring metal parts

The greatest danger from static electricity comes in the dry winter months, while in the summer time there is comparatively little danger In the winter time the danger may be lessened somewhat by moistening the air of the operating room The steam from the sterilizer may sometimes be utilized for this purpose

"Ethylene tanks should never be attached to any apparatus which has been used with oxygen nor should oxygen tanks be attached to any apparatus which has been used with ethylene, as explosion may occur when the high tank pressure is turned on In fact, reducing valves for ethylene are made with a left-hand thread, which fits the left hand thread on the large ethylene tanks and makes it impossible to attach these valves either to oxygen or nitrous oxid cylinders

"Explosion of ethylene within the tank itself seems altogether unlikely as these tanks are shipped freely by the manufacturers, and in the recorded instances where the gas has been ignited during administration no trouble has been experienced with the tanks The storage of extra tanks should receive attention A leaky tank in a small, ill ventilated room might form an explosive mixture A safety valve might conceivably blow, with the sudden release of a large quantity of ethylene The extra supply should therefore, be stored in a room shut off from the rest of the hospital but freely ventilated to the outside"[2]

[1] Sise Boston Med and Surg Jour, 192 7, p 287 February 12, 1925
[2] Ibid

A large proportion of the recorded explosions have taken
place before anesthesia was begun and as the mask was about to
be placed on the patient s face or after the anesthesia was
finished and as the mask was placed back on the machine   In
each case the ethylene flowing from the mask was undoubtedly
ignited by a static spark   We have made a practice of beginning
and ending our ethylene anesthesia with nitrous oxid   thus
eliminating the danger at these two particularly dangerous
points   We begin with nitrous oxid and shift to ethylene in
one half to one minute and shift back again to nitrous oxid about
five minutes before the end of the anesthesia   Besides eliminat
ing the danger of explosion at these two points the procedure has
two other advantages   The induction is pleasanter to sensitive
patients because the smell of nitrous oxid is less objectionable
than is that of ethylene   There is slightly less tendency to
nausea immediately after the operation because nitrous oxid
seems to be less nauseating than ethylene

SOME PHYSIOLOGIC ASPECTS OF POSTOPERATIVE TREATMENT

Robert L. Mason

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The application of knowledge gained by research in normal and pathologic physiology during the past few years has been of inestimable value to all forms of surgery. With a better understanding of the mechanisms underlying normal physiologic processes has come the appreciation of the effect of disease on these mechanisms. Attention has been diverted from therapeusis based on anatomic pathology to measures which tend to restore physiologic harmony. Improvements in biochemic methods have made possible qualitative and quantitative tests, which, together with an understanding of the disturbed physiology, furnish criteria which render diagnosis more exact, treatment more rational, and prognosis more certain.

A marked reduction of surgical mortality has been effected by preoperative preparation based upon data showing the functional condition of those organs which regulate the chemical physiology of the body. Equally important is the postoperative treatment based upon data of similar nature.

In our observation those cases which most need, postoperatively, the type of treatment based on underlying disturbed physiology fall into three groups:

1. Cases in which the operation removes the cause of the disturbed physiology, but leaves a residuum of the results of the previous disordered function to be reckoned with postoperatively. This group includes cases following operations for hyperthyroidism, high intestinal obstruction, biliary tract disease, and prostatic obstruction.

2. Cases in which the postoperative reaction brings about a train of symptoms which are a manifestation of disordered

chemical physiology   Examples are the development of post operative acidosis or alkalosis

3 A group of cases which, although presenting no definite symptoms, withstand operations poorly and do not react well during the postoperative period   Patients advanced in years or with vitality at a low ebb fall into this group

Since these groups include so large a portion of cases presenting themselves for major surgery, a complete discussion of their postoperative treatment would take more space than is here permitted   Accordingly, but a few fundamental facts of each will be indicated

HYPERTHYROIDISM

Hyperthyroidism furnishes a classical example of the first group   Most of the symptoms of thyrotoxicosis are incident to the high rate of energy exchange that occurs as a result of the elevated metabolic rate   Treatment of the disease consists in measures designed to combat these effects and in ultimate excision of a portion of the gland in order that the cause of the elevated metabolism may be removed   During the preoperative period all possible means are taken to combat the effects of the high metabolism   When the patients condition is improved to the highest extent possible with these measures operation is undertaken   In the immediate postoperative period the metabolism is considerably accelerated beyond the preoperative level While it is important to attempt to lower the metabolism by Lugol's solution and to quiet the patient by large doses of morphin the urgent indication is to meet the demands of the highly elevated metabolism   Chief among these is the need for fuel to supply the increased energy requirement   The food intake on the day of operation is apt to be greatly reduced Following the operation vomiting prevents adequate intake   The food reserves of the body are, of necessity called upon to furnish the required calories

Excessive oxidation of sugar takes place in hyperthyroidism and especially during this period   From data derived from a consideration of the total respiratory quotient in hyperthy

roidism,[1] 36 per cent. of a dose of 100 grams of glucose has been shown to be oxidized in two and a half hours; the normal figure is 18 per cent. Animal experiments by several investigators have shown a depletion of the glycogen in the liver in cases of induced hyperthyroidism. Postoperatively, with a sudden activation of metabolism and a diminution in the amount of food supplied, the available supply of carbohydrate is quickly reduced. With the glycogen stores depleted the proteins of the body tissues (of which 58 per cent. can be converted into carbohydrate) are broken down to meet the demand for a readily oxidizable food substance. Rapid weight loss occurs. The waste products of protein catabolism, urea, and ammonia, require elimination and throw an increased burden upon the kidneys. Fat, also called upon to furnish an increased amount of heat energy, is imperfectly oxidized in the presence of an insufficient supply of carbohydrate, and acidosis is prone to develop. The administration of glucose in a form readily utilizable is therefore indicated.

Ordinarily the carbohydrate may be furnished in drinks containing a considerable amount of carbohydrate, such as orange juice, ginger ale, etc., and by rectal glucose. In reactions of any severity, however, and especially when a thyroid "storm" seems imminent, the intravenous administration of glucose is indicated and, as a rule, is followed by a striking improvement in symptoms. Five hundred c.c. of a 10 per cent. solution should be given and repeated, if necessary, two or three times during the twenty-four-hour period.

Water is another fundamental requirement in the postoperative treatment of hyperthyroidism. The heat generated by the increased metabolism must be removed by evaporation, and for this purpose an increased supply of water is essential if dehydration is to be prevented. The intravenous administration of glucose in a 10 per cent. solution serves a double purpose, in that, besides glucose, a generous amount of water is supplied. To further supply the increased demand for water fluid should be given by rectum and the patient urged to drink large quantities of water in spite of emesis.

[1] Sanger and Hun, Arch. Int. Med., 1922, 30, 397.

INTESTINAL OBSTRUCTION

In high acute intestinal obstruction the associated toxemia remains to be treated following the operative removal of the obstruction A similar toxemia accompanies the high intestinal stasis which occasionally follows operations on the stomach or duodenum This toxemia has been shown by numerous investigators to be accompanied by definite chemical changes in the blood These are manifested by

1 Reduction in plasma chlorids

2 Alkalosis as shown by a rise in the carbon dioxid combining power of the plasma

3 A rise in the non protein nitrogen

The cause of the development of the hypochloremia and the attendant alkalosis is not clear Prolonged vomiting has been ascribed and probably does play some part although Haden and Orr have observed similar conditions following experimental obstruction in rabbits—animals who cannot vomit It has also been observed in pyloric obstruction accompanying gastric carcinoma in which no chlorids are lost in the vomitus by virtue of the achlorhydria present in this condition Starvation may be a factor The experimental work of Haden and Orr would indicate that the chlorids are utilized by the body as a protection *against the toxic agent generated by the obstruction* This toxic agent they believe has a marked destructive action on protein and to the resultant split products are due the symptoms associated with toxemia A sufficient concentration of chlorids prevents this tissue breakdown by effecting a combination of the chlorids with the toxic body which renders it innocuous Haden and Orr suggest the following equation as one conception of this protective mechanism

$$X + NaCl + H CO_2 = NaHCO_2 + XHCl \; (X = toxic \; agent)$$

The same observers have also shown that the rise in non protein nitrogen occurring in these cases does not occur until there is a considerable depletion of the chlorids (In one series the NPN did not rise until 25 per cent of the chlorids had been depleted) They have shown that if the chlorids are kept at a normal level

the non protein nitrogen does not rise, the CO_2 combining power of the plasma is not elevated and no symptoms of toxemia develop

This conception at least, furnishes a working basis for treatment in these cases and an explanation of the marked improvement which follows the administration of sodium chlorid and other measures to restore the blood chlorids to a normal level We have had excellent results in the treatment of these cases by the intravenous administration of large quantities (1000–1200 c c) of normal physiologic saline solution with the addition of 50 to 100 grams of glucose as advocated by McVicar   In obstinate cases we have accelerated the return of chlorids to normal values and lowered the CO_2 combining power to a normal level by the rectal administration of 300 c c of a 2 per cent solution of ammonium chlorid at four hour intervals   The efficacy of ammonium chlorid in combating alkalosis and raising the blood chlorids has been well shown by the work of Haldane, Ellis and others

A generous supply of water furnished by the massive intravenous infusion aids in eliminating the excess nitrogenous waste products and combats the anhydremia incident to the toxemia   The glucose added to the intravenous saline furnished a readily oxidizable food substance and spares the breakdown of tissue proteins

The blood chlorids and CO_2 combining power of the blood should be carefully followed in order that the subsequent treatment may be decided upon   The administration of ammonium chlorid should be stopped upon the return of the CO_2 combining power to normal values (50 70) since further administration may lead to acidosis

BILIARY OBSTRUCTION

In the routine case of gall bladder disease without jaundice or fulminating acute infection one does not often meet with serious postoperative sequelæ

When jaundice is present however the postoperative course is be et with three possible dangers

1 Hemorrhage
2 Failure of liver function
3 Kidney failure

These have been emphasized by Walters and his co workers at the Mayo Clinic

In patients who have had a careful study of their bleeding and coagulation time previous to operation and who have had these reduced to normal levels by a course of oral and intra venous calcium the danger from hemorrhage is not great If considerable blood is lost at the operation transfusion immedi ately afterward should be done as a precautionary measure Since the improvement in the coagulation time is not always sustained calcium lactate should be given by mouth 100 grams daily for at least five days following the operation If not *tolerated by mouth it should be given by rectum* Besides accelerating the coagulation time the calcium may have some detoxifying effect upon the excess bile pigment in the blood as suggested by King and Stewart If hemorrhage occurs in spite of these measures transfusion must be done without delay

The other two possible complications are often confused Liver failure is apt to occur several days after operation during which time the patient has appeared to be making a satisfactory convalescence Its onset is accompanied by a thinning in color and increase in amount of the bile drainage The patient becomes apathetic listless and marked emaciation occurs in a surprisingly short time The jaundice does not appreciably deepen The phenoltetrachlorphthalein test of Rosenthal shows an increasing degree of dye retention Urinary output is com mensurate with intake Since the manufacture of urea is a function of the liver the blood urea remains at a low level although the total non protein nitrogen may show a rise due to the *increased endogenous protein metabolism* Acidosis is prone to occur due to the imperfect oxidation of fat in the presence of insufficient carbohydrate The patient fails rapidly and goes into a state of collapse

In kidney failure however the patient is apt to have a prolonged initial operative recovery with vomiting nausea,

and distention The bile drainage is of normal color, but of small quantity The urinary output is decreased The serum bilirubin increases and the jaundice deepens The blood urea, the non protein nitrogen and the blood creatinin show marked elevation and the excretion by the kidney of phenolsulphthalein is at a low level The urine shows marked albuminuria and the sediment showers of casts Uremia rapidly develops

While these two serious complications with their typical manifestations are fortunately, not common, milder degrees of each or their combination are frequently encountered following operations for biliary obstruction in which jaundice has been severe Some degree of liver impairment as shown by the phenol tetrachlorphthalein and levulose tolerance test, almost always exists if the jaundice has been of more than temporary duration The toxic action of the bile salts and bile pigments upon the kidney is well known Haessler[1] and his associates have found extensive degenerative changes in the tubular epithelium of the kidneys of dogs jaundiced for a considerable period The glomeruli were practically unaffected One would infer from these and other reports of the toxic effect of bile upon the kidneys that the margin of safety as regards the renal mechanism is distinctly lessened in obstructive jaundice If the patient already has renal damage the added increment of pathologic changes incident to jaundice may be sufficient to bring about renal failure especially after operation when the effect of anesthesia has added to the kidney burden

The specific action of glucose in liver impairment has been well demonstrated by the work of Mann After extirpating the livers of dogs he has been able to keep them alive and active for thirty six hours with intravenous glucose Dogs which did not receive glucose developed a progressive hypoglycemia and died in six hours Clinically, in failure of liver function the use of glucose is attended with very satisfactory results and in cases of liver failure after operation as noted above is urgently indicated In these cases it is best given as a 10 per cent solution in

normal saline   Fifty grams of glucose may be given in this way
and repeated two or three times during the twenty-four hour
period   Care must be taken that this solution is given slowly or
a considerable portion will be lost in the urine   At least one hour
should be taken in the administration of 50 grams of glucose
In addition to the carbohydrates furnished intravenously the
patient should receive a copious supply of carbohydrate in drinks
and in his diet   Fluids should, of course, be forced   Ox bile by
mouth may be of value by virtue of the cholagogue action of
its bile salts

In kidney failure intravenous glucose is of equal value, but
should be given in a 10 per cent solution with distilled water
rather than saline solution   The glucose acts both as a readily
oxidizable food substance and as a diuretic   The large amount
of fluid combats the dehydration and facilitates elimination
The other usual measures for restoration of kidney function are,
of course, indicated   Drains should be carefully inspected to
make sure that they are not obstructing the outlet of bile

ACIDOSIS AND ALKALOSIS

The prolongation of the initial operative recovery after any
major surgical operation, with persistent vomiting restlessness
alternating with periods of languor together with slight eleva
tion of temperature and flushed skin, lead one to suspect acidosis
The circumstances incident to the operation are propitious for
its occurrence

Previous to operation the food intake has been limited,
especially in acute cases or where there has been considerable
vomiting   Fluids and food are apt to be reduced in anticipation
of the anesthetic   Following the operation food intake is neces-
sarily at a minimum and much fluid is lost through vomiting
and profuse perspiration   The glycogen reserve of the liver
is rapidly depleted   The body must now derive its heat energy
from the fat and protein of its own tissues   In the presence of
insufficient carbohydrate combustion of fat is incomplete and the
intermediate products of fat metabolism, acetone, diacetic
acid, and beta-oxybutyric acid accumulate in the blood stream

There results a diminution of the alkali reserve from the combination of these acids with the circulating bases   The carbon dioxid combining power is reduced   Acetone bodies appear in the urine   The anhydremia present acts in conjunction with the acetone bodies and diminished base to produce the clinical symptoms of acidosis   Talbot Shaw and Moriarty,[1] in a study of fasting children with acidosis have shown that there were few subjective symptoms as long as large amounts of water were ingested and excreted   When the fluid intake was materially diminished   their patients became flushed anxious, languid, and complained of abdominal pain

Since the condition is due to an insufficient supply of carbohydrate, the administration of this substance results in prompt disappearance of the ketosis and a return of the carbon dioxid combining power to normal values   Sufficient carbohydrate may be given by mouth if the patient is able to retain it, most of them cannot   By rectum glucose is apt to be irritating and even with considerable dilution is not well tolerated   We have had very satisfactory results as in other instances, where carbohydrate is urgently indicated by the intravenous injection of a 10 per cent solution of chemically pure glucose in normal saline solution   Fifty to 75 grams may be given in this way at one administration and in addition a generous amount of fluid supplied   The results are striking and usually follow one intravenous injection   Vomiting stops restlessness is allayed, and the patient experiences a considerable measure of subjective relief   Insulin has been advocated as an adjunct to the glucose in hastening its oxidation   We have used this procedure in a few cases but can see no advantage over the administration of glucose alone   In postoperative acidosis there is no inability to utilize carbohydrate, the difficulty lies in an inadequate supply   If introduced slowly, the glucose by vein is efficiently utilized and the acidosis relieved   Insulin in the non diabetic has been shown to reduce the glycogen content of the liver, and in these cases with the carbohydrate reserve at a low level further depletion would be unwise

[1] Talbot Shaw and Moriarty   Jour Amer Med Assoc   83 93 1924

The use of alkalies commonly sodium bicarbonate, in the treatment of surgical acidosis is unnecessary and may often be harmful Aside from the danger of tetany from overdosage of alkali the amount of base required to neutralize the ketone bodies would produce an absolute excess of base in the blood and in this way disturb the normal equilibrium of the body fluids Sodium bicarbonate is excreted with difficulty if any renal impairment exists and its retention leads to edema

In many cases suspected of acidosis because of prolonged vomiting restlessness and headache the CO_2 combining power will be found to show a condition of alkalosis rather than acidosis This may even occur in cases showing acetone bodies in the urine and illustrates the value of determining the CO_2 combining power of the plasma in suspected cases of acidosis Tetany occurs in severe cases with a CO_2 combining power over 90 volumes percentage

As in the alkalosis accompanying intestinal obstruction, there is apt to be a reduction in the plasma chlorids The NPH however is usually not elevated In these cases vomiting has been prolonged and the condition is undoubtedly due to loss of hydrochloric acid in the vomitus Similar blood chemical changes however may occur with slow dilatation of the stomach with accumulation of gastric secretion

The treatment of this variety of alkalosis is the same as that described for the alkalosis associated with the toxemia of intestinal obstruction Intravenous glucose in normal saline solution as described is of great value In addition in severe cases or if the CO_2 combining power remains persistently high, ammonium chlorid may be given by rectum in a 2 per cent solution 10 ounces at one administration

PROSTATIC OBSTRUCTION

In prostatic obstruction operation is only undertaken after a preoperative period during which intravesical tension and congestion have been relieved by suprapubic or urethral drainage The patient during this time has been able to establish a certain amount of immunity to infection from the bladder, and the

retention of nitrogenous waste products has been brought down to a normal level by copious fluid intake After removal of the prostate there is a tendency toward return of the pathologic conditions relieved by the above measures The congestion and edema of the bladder incident to the prostatectomy act reflexly on the renal blood pressure and the rate of urine flow is decreased There may be an exacerbation of bladder and ureteral infection if this has been a prominent factor before operation These interfere with efficient kidney function If, however, the accumulation of nitrogenous waste products can be kept at a minimum for a few days following the operation the congestion and infection tend to subside The inefficient kidney in the face of its added burden is able to do this only by copious excretion of a poorly concentrated urine For this purpose fluids must be forced to at least 3000 c c daily Most cases are unable to maintain this high level by mouth, and the fluid must be given by hypodermoclysis or by vein We have found the intravenous route to be the most satisfactory It is far less painful to the patient and has the advantage of being taken into the circulation at once Fluid is often inefficiently absorbed from the subcutaneous tissues One thousand c c of normal saline may be given at one intravenous administration

The diet should be one which leaves but small residue of its end products for excretion by the kidneys Carbohydrates furnish heat energy efficiently and place no burden upon the kidneys They should comprise a large portion of the diet

If food is not taken adequately by mouth, glucose may be added to the intravenous saline solution

DEBILITATED PATIENTS

In the third group of patients are those who though presenting no definite syndrome, react poorly to the operative procedure and in spite of the usual restorative measures, go steadily down hill They are not in shock, nor have they lost much blood They are usually advanced in years or by reason of their illness or otherwise have been invalids over a long period of time On investigation dehydration is a prominent factor in

their condition and has usually been of long standing Blood
volume is diminished and viscosity of the blood increased in the
resultant desiccation Tissue oxidation is inefficient due to the
increased viscosity Kidney function is inefficient because of
the high concentration of the waste products brought to it for
excretion

In anhydremia of short duration the blood volume may be
replaced by generous administration of fluids but when of long
standing the reparation process is slower and the normal volume
is not restored until the blood cells (a certain number of which
are destroyed in prolonged desiccation) and the serum protein
are restored to normal proportions. This is best done by blood
transfusion which in this group of cases is attended by most
satisfactory results

In addition this group must have careful individual atten
tion They chill easily and are especially prone to respiratory
infections They must be kept warm Food must be appetizing
and abundant Fluid intake must be kept at a high level

SPINAL ANESTHESIA

LINCOLN F SISE

WHILE spinal anesthesia is used considerably by a few men,
it is not used by as many surgeons and anesthetists as it might
be   In this clinic while the actual number of cases in which it
has been used is small yet in these cases it has filled a need
which it would have been difficult to meet so satisfactorily in
any other way

ADVANTAGES

It has practically no deleterious action on most of the impor
tant vital centers—the lungs kidneys and liver and little but
a secondary effect upon the heart   Metabolic equilibrium is not
disturbed   Relaxation is excellent   Recovery is prompt and
usually unattended by nausea and vomiting   Consequently,
liquids and frequently food need not be restricted for as long a
period as after an inhalation anesthetic   The general upset to
the patient following operation is strikingly less than it is after
an inhalation anesthetic

It has also certain advantages over other forms of regional
anesthesia   The technic is fairly easy and simple and with
slight modifications is applicable to a wide range of operations
over a large portion of the body   Thus it can be learned and
used by men who have not the time the opportunity, or per
haps the aptitude to learn the numerous and more intricate
procedures necessary for the same operations when other forms
of regional anesthesia are used   Its induction is less painful to
the patient than is that of many of these other forms   In many
cases both anesthesia and relaxation are better

DISADVANTAGES

It is very generally believed that there is more danger to
this form of anesthesia than to the more commonly used gen

eral anesthetics   The rates given by different observers are higher   There are reasons however why it is unfair to compare these rates with those for the general anesthetics

1   Spinal anesthesia is frequently used where the condition of the patient is such that for one reason or another a general anesthetic is considered dangerous   In this clinic at least it is used mainly where there is some decided objection to a general anesthetic   where the condition of the patient is such that a general anesthetic appears to be more dangerous than spinal anesthesia

2   Much of the reported mortality of spinal anesthesia has been with drugs and methods much inferior to those of today   Only recently has the mechanism been clearly understood of the drop in blood pressure so frequently seen and only recently has an effective treatment been developed for this   And finally it may be said that most really effective agents or methods are not free from danger if used improperly

Another disadvantage of this method is that there is occasional failure to get anesthesia high enough or even to get any anesthesia at all   The failures given by different observers vary from about 1 to about 6 per cent   The length of the anesthesia is limited varying chiefly with the amount of the drug used   The retention of consciousness is also a disadvantage with most patients but if necessary this can be overcome by giving a light gas anesthesia just enough for loss of consciousness

The after effects are usually slight at most   With proper technic they are less than after most general anesthetics

MATERIALS

Quite a number of different drugs have been used   the chief ones being novocain stovain tropacocain and apothesine   We believe novocain to be the best of these largely because where pure novocain is used there appear to be fewer unpleasant after effects than where any of the other drugs are used

The needle should be made of nickel   Steel needles are subject to rust and may break off between the vertebrae during an injection   Platinum iridium is too soft to take a good point   A sharp point is very desirable so that the hole in the dura

shall be clean and small, so as to close easily A dull needle may tear a rent The nickel needle is rustless, will not break, and takes a fairly sharp point The bevel of the point should be short so that when the bevel is just entirely within the membrane the end of the point will still be not too far in The length of the needle should be about $3\frac{1}{2}$ inches The gage most commonly used is 17 to 18 Stubs English wire gage We are using with great satisfaction a finer needle No 19, Stubs' gage A smaller gage even than this may be used The small gage needle is less painful to the patient, requires less force to introduce it, lessens the possible force of the injection, and makes a smaller hole in the dura Its only objection is its limberness This makes it more difficult to guide the needle during its introduction and makes it necessary to grasp the shaft with the fingers in order to keep it from bending There is also needed a 20 c c glass syringe to fit the needle, and a small glass beaker in which to dissolve the novocain An ordinary hypodermic needle may be used to anesthetize the skin for the puncture and for subcutaneous medication should it be necessary Apparatus for the intravenous injection of salt solution completes the outfit, and should be sterilized, ready for immediate use when the anesthesia is started

TECHNIC

Surgical asepsis is used throughout It seems possible that some of the unpleasant sequelæ noted in the past may have been due to low grade infection For the skin we scrub twice thoroughly with ether and then use half strength tincture of iodin In boiling the instruments care should be taken that no bicarbonate of soda is used in the water A rubber glove is used for the right hand, so that the bare fingers shall not come in contact with the shaft of the needle The syringe, needles, and beaker are all rinsed in sterile distilled water

The introduction of the spinal needle is done with the patient in the sitting position, or, if he is unable to sit up then with him lying on one side The important point in his position is that the back be well arched so that the spinous processes are separated as widely as possible He should sit across the operating

table as far back as possible so that the knee comes at the edge of the table   The feet should be supported by a stool and an attendant should stand in front of him to steady him and see that the back is kept well arched

While the skin of the back is not highly sensitive so that local anesthesia for the puncture is not absolutely necessary yet it is a good plan to make a wheal in the skin with novocain at the site of puncture   Puncture of the skin is a little more painful without the wheal and this fact makes the patient more apprehensive and less likely to co operate well in arching the back

LANDMARKS

A line drawn between the crests of the ilia will usually cross the spine at the spinous process of the fourth lumbar vertebra or just below it (Fig 235)   In palpating the ilia in fat people due allowance should be made for the thickness of fat which may be rolled up over the crests   A convenient method of palpating the ilia without breaking asepsis is to fold a towel lengthwise place the hands within the fold and palpate so that one side of the towel is between the hands and the patient   the other side falls back over the hands and the edge is used as the line between the crests (Fig 236)   If care is taken and the edge is manipulated so that it is straight and its ends are just on the crests this method is quite accurate   Having determined which spine is the fourth it is easy to count from this to any desired space

We usually make a practice of checking this procedure by finding the twelfth dorsal spine according to the method recommended by Labat   To do this palpate the twelfth rib and find on it a point 5 cm from the midline   If this 5 cm is perpendicular to the midline the point where it reaches the spine will be the spinous process of the twelfth dorsal vertebra (Fig 235) If the spinous processes do not coincide when found by these two different methods an error has probably been made and the two procedures should be repeated until each checks the other as being correct

The Puncture —There are two methods by which puncture may be made (1) With the thumb and forefinger make the

skin tense over the selected interspace and puncture the skin
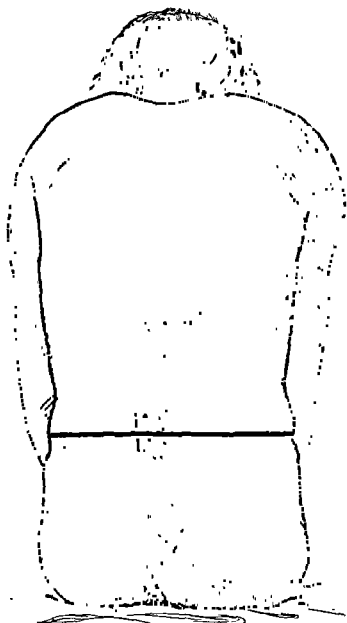in the midline half-way between the two spinous processes.

Fig 235 —Landmarks for determining spine. Dark line is at height of iliac
crests.

When the skin has been punctured, verify the position of the
needle before advancing it to the deeper structures. Then

advance it exactly in the median line at right angles to the plane
of the skin of the back   If puncture is unsuccessful and bone is
encountered, the needle should be largely withdrawn and re-
inserted, pointing very slightly upward   If this, again, is unsuc-
cessful, it should in the same manner be pointed slightly down-
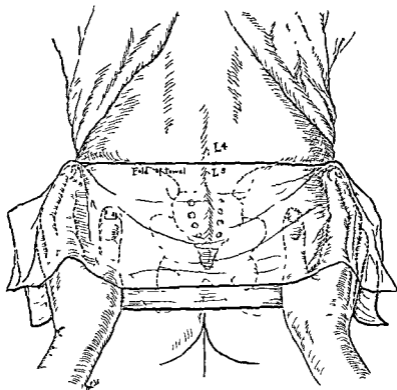ward   Or it may be withdrawn so that the point is engaged

Fig 236 —Method of palpating iliac crests while sterile

in the skin alone, and the skin then pulled down slightly so that
puncture is made a little lower, when the needle should be slanted
up slightly   By manipulations of this sort *puncture is rarely
unsuccessful*   If still unable to enter, success may sometimes be
had by the second method of puncture

(2) Select a point ½ inch to one side of the midline and on a
level with the superior edge of the spinous process below the

interspace selected   Again make sure of the position of the needle after piercing the skin   Then advance it slightly upward and inward so that the point shall be in the midline at the time the spinal canal is tapped   In making each puncture the stylet of the needle should be in place   As the ligamentous subflavum is pierced the resistance decreases considerably Advance now very slowly and gently till a slight snap is felt On withdrawing the stylet spinal fluid should flow   If at any point difficulty is experienced, make sure that the patient's back is still well arched

Sometimes when fluid is obtained the flow is very slow and if a syringe is attached to the needle and suction made, it stops entirely   This is probably due to a flap of the dura over the end of the needle, which closes like a valve when suction is used The needle may then be rotated or advanced a little or withdrawn a little to clear the opening of the needle from the obstruction   When a free flow is once established, great care should be used to see that the needle does not move in the slightest from the correct position   The needle may be held in the fingers of the left hand with the wrist steadied against the patient s back Withdraw the desired amount of cerebrospinal fluid into the syringe, but stop immediately if at any time headache appears The novocain, previously placed in the glass beaker, should now be dissolved in the spinal fluid   It is essential to see that it is dissolved thoroughly and mixed uniformly with the entire amount of fluid   When the syringe is filled with this solution and has been attached to the needle it is well before injecting to withdraw a very little fluid to make sure that no air, which might be injected has remained in the needle   The injection should be made quite slowly   Forcing the fluid tends to send it higher   Two or three times in the course of the injection it should be stopped and a little fluid withdrawn in order to be
•sure that the needle is still in the correct position   With the injection finished the needle is quickly withdrawn, the puncture sealed with collodion, and a firm sterile dressing applied   The patient may later be moved about on his back, so that if this dressing is not quite firm it may be torn off

Up to a certain point the length of the anesthesia varies with
the concentration of the drug which is brought in contact with
the nerves   Thus it varies directly with the amount of the
drug used and inversely with the extent of the anesthesia   It
lasts ordinarily from three quarters of an hour to an hour and a
half most commonly about an hour   In one case of ours it
lasted but twenty minutes, while in another case it lasted well
over two hours and was sufficient for the complete operation,
abdominal and sacral, for carcinoma of the rectum

HEIGHT OF ANESTHESIA

The height of the anesthesia is dependent on a number of
different factors, chief of which are the site of the puncture,
the force of injection, the amount of fluid withdrawn, the effect
of gravity and to some extent the amount of the drug used
These factors are used in different ways by different men in
getting the desired height of anesthesia

The method of which Jonnesco has been the chief exponent
depends mainly on the site of puncture   This has the great
advantage both that the area anesthetized may be limited more
strictly to the field of operation and that it may even be limited
to some extent to the posterior roots, so that the anterior roots,
which contain vasomotor control, are not deeply and com
pletely blocked   Thus by this method there is apt to be less
vascular depression than by the methods of diffusion   But a
serious objection to this method is that the cord is more liable
to injury than where the puncture is made always in the lumbar
region   The cord ends usually at the level of the first lumbar
vertebra though occasionally it may reach as far as the lower
border of the second   Thus if puncture is made below this latter
place, the cord itself will be safe   Punctures above this point
can, of course usually be made without injury as the point of
the needle is stopped in the subarachnoid space before the cord
is reached   But, unfortunately, the subarachnoid space is occa
sionally absent because the arachnoid membrane is adherent to
the cord along its posterior surface   Thus when puncture is
made the needle on piercing the arachnoid will go directly into

the cord   If fluid is withdrawn it may come from in front of the cord after the needle has gone entirely through the cord It seems to us therefore, safer to make the puncture always in the lumbar region and get the desired height in another way The method outlined here has given satisfactory results in our hands

The site of puncture is the second lumbar interspace for all operations above the groins   The third interspace may be used for thigh operations and the fourth for operations on the leg or perineum

We have not used force in making the injection in order to gain height   It has seemed to us that it would be difficult to measure the amount of force and that the control of diffusion in this way would be uncertain

We have found the amount of fluid withdrawn to be the most satisfactory manner of determining the height of anesthesia   In addition to regulating the height of anesthesia, the dilution of the drug which necessarily accompanies this method makes also for safety   Where a dilute solution is injected, it is fixed more readily in the tissues and there is not so apt to be an excess left over after fixation which might, with a change of position of the patient be gravitated toward the vital centers in the medulla   The larger the amount of fluid withdrawn, the higher is the anesthesia   One cannot make an exact scale of height for certain amounts withdrawn because this varies somewhat with different individuals   But in general we have found that with men when the injection is made in the second lumbar interspace, if 10 c c is withdrawn, the anesthesia will reach to the groins, 15 c c , to the umbilicus, and 17 or 18 c c , to the epigastrium or midchest   One should stop the withdrawal of fluid immediately on the appearance of headache   This, however, is quite unusual

The larger the amount of the drug, the higher is the anesthesia   The effect of different quantities of the drug, however, is not marked in this respect   The greatest effect is seen in the depth and length of the anesthesia

We buy the drug in crystallized form a measured dose, steril-

ized in a sealed ampule ready for use In general the dose is made to equal approximately 10 mg for each 15 pounds of body weight The usual minimum dose however is 100 mg

In a few small and weak individuals this is reduced to 90 or even 80 mg in certain instances For a very low anesthesia as little as 60 mg may be used successfully The maximum dose for any individual is 120 mg

CONDUCT OF THE ANESTHESIA

As soon as the injection is completed the patient is immediately laid flat upon the table The head may be raised upon a pillow but it is illogical to raise the shoulders in addition The reverse is more apt to be necessary Consequently shoulder pieces should be put in position ready for immediate use Where the method here described is used it seems quite certain that the patient can be put in Trendelenburg position immediately after the injection is made without danger of the drug gravitating to the higher nerve centers But unless there is some good reason for the immediate assumption of this position it is more conservative to wait till the drug has had time to become fixed in the tissues This is probably accomplished in a very few minutes ten at the most when it is absolutely safe and usually beneficial to incline the head of the table downward A hypodermic syringe for adrenalin and apparatus for the immediate administration of salt solution should be sterilized and ready

It is very essential during anesthesia that a careful watch be kept upon the patient The blood pressure especially should be watched but the respiration should not be neglected The breathing of these patients is usually quiet and shallow and unless attention is paid to it it is perfectly possible for it to stop without this fact being noticed

Anesthesia usually sets in from four to ten minutes This may now be tested for by the prick of a pin When the operation is finished and the patient is moved to bed he should be treated very gently and care should be taken that he is not jarred in being transferred from one place to another In all except the

lower anesthesias, the patient should be kept flat in bed until recovery from the anesthesia begins to take place and vasomotor control is re-established. Any raising of the upper portion of the patient's body before this time may induce syncope which may prove fatal.

Anesthesia starts in the perineum and feet and progresses rapidly up the body until near the height which it will eventually reach, when it progresses more slowly. In the higher anesthesias, roughly, those above the groins, a certain amount of drop in blood-pressure is usual. Where this occurs the patient presents certain characteristic phenomena—pallor, sweating, thirst, sometimes nausea, and frequently a certain amount of mental dulness. Watch carefully the patient who is very quiet. The reason for this drop in blood-pressure is a paralysis of vasomotor control, particularly control of the great splanchnic pool. The anesthetic paralyzes not only the nerves of sensation but also the motor and vasomotor nerves. Fortunately, these motor nerves are affected less deeply than are the sensory nerves. The vasoconstrictor fibers emanate from the cord in the region between the level of the second dorsal and that of the third lumbar spinal roots. The great splanchnic pool is controlled by the region from the sixth dorsal to the third lumbar. Consequently, practically all of these vessels are relaxed in an anesthesia extending to the ensiform cartilage, and a pronounced drop in blood-pressure is usually apparent. This drop is usually accompanied and probably accentuated by a slowing of the heart rate. It is possible that this slowing may at times be produced at least in part by blocking of the upper dorsal nerves.

The anterior roots of these nerves convey sympathetic fibers to the heart which normally oppose the action of the vagus, so that their partial or complete blocking may leave the vagus partly or wholly free to exert its slowing action on the heart.

Young patients are less affected by this drop in blood-pressure. The older patients, and those with arteriosclerosis, are usually affected the most severely. The effect of a given degree of vascular depression varies with different individuals, but in general if the drop in pressure does not reach below 90

mm systolic blood pressure, it is considered quite satisfactory If it reaches to 50 or 70 mm, mild measures may be instituted If it reaches to 30 or 40 mm, effective treatment should immediately be instituted

TREATMENT OF DECREASED BLOOD PRESSURE

In the treatment of the milder degrees of depression one may resort to the following measures

1 The table may be tipped so that the head of the patient is lowered This is one of the quickest and easiest things to do The table may well be put into an extreme incline Many have objected to this procedure on the ground that the novocain might gravitate to the respiratory center and cause failure of respiration With the technic outlined, however, the novocain is so diluted and is taken up by the tissues so promptly that there is no danger of this accident happening We have used this position repeatedly and have operated on patients in Trendelenburg position and have never seen any but beneficial effects from it

2 The inhalation of carbon dioxid to the point of moderate stimulation of respiration or the inhalation of ammonia or ether gives mild stimulation We have not used ammonia or ether, but have had very good success with carbon dioxid

3 Five to 10 minims of adrenalin may be injected subcutaneously This gives somewhat greater and more prolonged stimulation Care should be exercised that the adrenalin is not injected into a vein If the whole dose were injected directly into the blood stream excessive stimulation would ensue, with later corresponding depression

4 Oxygen especially in conjunction with carbon dioxid may be given by inhalation While oxygen is not in itself a stimulant yet it is very beneficial where depression of circulation and respiration have reduced greatly the oxygen carried by the blood

While these methods are effective for the mild degrees of depression they are not sufficient for anything very severe For severe depression we believe the method advocated and so

clearly set forth by Babcock is the really efficient one   The
drop in blood pressure is caused by a paralysis of the nerves
conveying vasomotor impulses from the cord outward   It is
impossible therefore to accomplish anything by central stim
ulation   The action must be peripheral   Adrenalin produces
vasoconstriction by peripheral action and is therefore still
effective even though the vasomotor fibers leading from the cord
are blocked by our spinal injection   Moreover its greatest effect
is exerted in the splanchnic area where it is most needed and
there is apparently no effect on the coronary arteries so that the
blood supply of the heart muscle is not reduced   Thus it would
appear that adrenalin might very nearly reverse the action of
our spinal block on the circulation and that it would, therefore,
be an almost ideal drug for treatment of the lowered blood
pressure

The results of treatment must be secured immediately
Therefore the adrenalin must be placed directly in the circula
tion   At the same time, as its action is but short lived, this
action must be continued by means of repeated small doses
In practice the best way to do this is by means of intravenous
salt solution to which adrenalin is added as needed   The
needle of a hypodermic syringe filled with adrenalin may be
thrust into the rubber tubing of the intravenous salt solution
apparatus close to the needle in the vein so that any adrenalin
injected is immediately carried into the circulation by the salt
solution   One to 3 minims at a time may be added as needed to
produce a moderate continued stimulation and to maintain the
blood pressure at about 80 or 90 mm systolic   We know that
the vasomotor paralysis induced by the novocain will wear off
in a comparatively short time and that the patient will then
be all right   All that is necessary is to tide him over this period
This the adrenalin is well fitted to do

Respiratory Failure —This is a complication which has been
much talked of as being due to paralysis of the respiratory mech
anism caused by too high diffusion of the drug in the spinal canal
Such a paralysis has probably taken place in a few cases   It
seems highly probable, however, that in most of the cases res

piratory failure has been secondary and due to lowered blood pressure and not to a direct action of the drug on the respiratory center In an anesthesia extending to the epigastrium we need to get only as high as the seventh dorsal nerve while to get direct paralysis of respiration we would have to anesthetize the third fourth and fifth cervical nerves In operations on the lower abdomen therefore there is a considerable margin between the anesthesia necessary for the operation and that which might produce paralysis of respiration Moreover a very deep anesthesia of the cervical nerves is necessary to paralyze the respiratory functions as their sensory portions have been well anesthetized without producing paralysis of respiration The usual treatment therefore of respiratory failure resolves itself into that of lowered blood pressure Of course artificial respiration must be resorted to if respiration actually ceases whether the failure be due to lowered blood pressure or to actual blocking of the nerves of respiration

Incontinence of Feces —This is not infrequent with a pro found anesthesia if there is anything in the rectum Therefore it is well to see that cathartics and enemata are given long enough before operation so that the rectum shall be empty This is particularly important in pelvic operations where the patient is in the Trendelenburg position and especially so in abdominal hysterectomy as the feces might then flow up through the vagina into the abdominal cavity

Nausea —This may be caused during the anesthesia by a sudden drop in blood pressure it may be psychic or in abdominal operations it may be due to pressure of packing toward the epigastrium The treatment would be that appropriate to the condition causing it

AFTER EFFECTS

These are usually slight or absent if proper technic is employed One of the great advantages of this method of anesthesia is the absence of after effects The incidence of after effects is reduced by first using novocain second a pure drug, third scrupulous asepsis fourth the absence of any foreign body

in the fluid injected   This is accomplished by rinsing in distilled water all the instruments used, by using spinal fluid to dissolve the drug, and by taking care that no bubble of air is introduced during the injection, fifth, by a correct puncture   The wound in the dura should be clean, such as is made by a sharp needle, should be in the median line, and below the second lumbar vertebra

The most common after effect is headache   This appears a few hours to a day after anesthesia   It usually yields to quiet and aspirin, but may be quite severe and persistent   Insomnia is next in frequency   There may be temporary and mild paralysis   Abducent paralysis of the eyes is the most frequent

INDICATIONS

Spinal anesthesia may be used in any operation below the umbilicus and frequently to advantage   It is indicated in such operations when there is some reason against the use of other anesthetics   We have used it especially in suprapubic prostatectomy and in second stage carcinoma of the rectum   The fact that there is little or no interruption to the taking of liquids is of great value in prostatectomy   We have also used it, and always with good success in operations on the pelvic organs when some condition, such as age, vascular disease, or lung complications, made a general anesthetic inadvisable   As the sympathetic fibers to the stomach and intestines are partially or completely blocked, the inhibitory action which they normally oppose to the vagus is lessened or removed and the stomach and small intestines are contracted and peristalsis is increased   This condition together with the excellent relaxation of the abdominal walls, makes this anesthesia very favorable for the work of the surgeon in abdominal operations   In operations on the legs or perineum the indications may be made more liberal, as the drop in blood pressure experienced with the higher anesthesias is in these low anesthesias very slight or absent   For these latter operations it therefore seems to us a decidedly safe method of anesthesia

CONTRAINDICATIONS

While this method of anesthesia has been used for opera
tions in all parts of the body yet in general its danger increases
directly with its height and few men have felt like using it in
operations above the abdomen   While upper abdominal opera
tions may well be performed under this anesthesia we feel that
the indications for it should be quite strict   Thus far we have
limited ourselves almost entirely to operations below the um
bilicus   Operations above this point besides being more liable
to a severe drop in blood pressure have the additional disad
vantage that the Trendelenburg position the most favorable
position for the anesthesia is unfavorable for the surgery

Low blood pressure is a contraindication which increases in
force with the height of the anesthesia contemplated   A systolic
blood pressure of 110 m would be against a spinal anesthesia of
such height that a drop in blood pressure would probably ensue
but would not necessarily prevent a low anesthesia of the leg or
perineum where any appreciable drop in pressure would be
quite unlikely   Spinal anesthesia should not be used in a con
dition of shock or in any other condition in which low blood
pressure is likely to ensue apart from the anesthesia   Consider
able caution should be exercised in deciding to use it in the
presence of myocardial degeneration as in this condition the
heart muscle may not bear well any considerable drop in blood
pressure   It is contraindicated in active syphilis   It is unsuit
able in long operations as the anesthesia may wear off before
the end of the operation   Usually a length of about one hour for
the anesthesia can be relied upon

SUMMARY AND CONCLUSIONS

Spinal anesthesia is a form of anesthesia which for operations
on the leg or perineal region is decidedly safe and for operations
as high as the umbilicus is in certain cases safer and better than
other anesthetics

Its chief danger is its effect in lowering blood pressure   This
effect can be largely guarded against by proper selection of cases
and by proper technic and can be remedied by proper treatment

MASSIVE ATELECTASIS

Robert L. Mason

Since 1914 when Pasteur called attention to the not infre
quent occurrence of collapse of the lung after major surgical
operations case reports of this postoperative sequel have been
increasingly numerous   The following case, however, is so typ
ical and illustrative of several features of the condition that its
presentation here appears warranted

REPORT OF CASE

Mr F D   aged eighteen, white a machinist by trade, was
admitted to the clinic for repair of bilateral inguinal herniæ
One week before entrance while lifting a heavy weight, he had
experienced a pain in his right groin   On investigation a
reducible mass the size of an orange was discovered in the
scrotum, where it had remained except when reduced by manip
ulation

His family history was negative, as was also his past history
He had had most of the children's diseases without sequelæ
He had had no colds or history of upper respiratory tract infec
tion during the preceding year

Physical examination showed a well developed young man
of eighteen in apparently excellent general condition   There
was a scrotal hernia on the right and a small indirect hernia on
the left

On November 21st repair of the herniæ was done   Anes-
thesia was by nitrous oxid oxygen ether sequence, with open
ether maintenance   Throughout anesthesia there was but very
little mucus   The operation itself was without particular
incident

Aside from urinary retention during the first twenty four hours requiring catheterization, the initial operative recovery was uneventful There was a moderate amount of pain in the left groin which was relieved by codein On the evening of November 23d fifty five hours after operation the patient s condition showed a definite change He stated that he had suddenly

Fig 237 —On the left side but a small amount of lung tissue is seen at the apex The heart shadow and d aphragm are obscured Note marked displacement of trachea and med astinum to the left

felt suffocated The feeling of suffocation was followed by dysp nea and a dull pain beneath the xiphoid There was a dry, unproductive cough The temperature, which previously had ranged around 99° F , was found to be 103° F , the pulse rate had risen to 120, and respirations to 48 Any movement in bed resulted in accentuation of the dyspnea and brought on

paroxysms of coughing. There was slight cyanosis He appeared critically ill

The left side of the chest appeared immobile and definitely flatter than the right. Auscultation and percussion were somewhat unsatisfactory because of the difficulty in moving the patient. Anteriorly there was dull tympany up to the fourth

Fig 238 —Taken thirteen hours after Fig 237 The heart outline can be made out and also some of the diaphragm Two thirds of the lung is clearing (This has been reversed in reproduction)

rib, above this there was dulness Posteriorly the whole left side was dull There was distant bronchial breathing throughout the left chest Breath sounds were distant and tactile fremitus diminished There were no râles The right chest was somewhat hyperresonant The outstanding feature of the examina-

tion however was the marked displacement of the heart upward
and to the left The apex impulse was seen and felt in the third
space left midaxillary line The heart sounds were best heard
in the second space midclavicular line where a slight thrill
could also be felt There were no murmurs Due chiefly to the
marked cardiac displacement a diagnosis of massive collapse
was made and corroborated by x ray (Fig 237)

F g 239 — N neteen hours after F g 237 The lung mark ngs show some
ncrea se and the heart outl ne s becoming more character st c

About six hours after the onset the cough which heretofore
had been dry became productive of a considerable quantity of
thick tenacious greenish purulent appearing sputum From
this time on the patient experienced marked subjective improve
ment During the subsequent six hours the temperature dropped
from 103° to 99 2° F the pulse to 96 and respirations to 30

At this time the apex impulse was felt in the fourth space, left anterior axillary line   Figure 238 shows the change that had taken place since the preceding x ray examination at the onset of the collapse thirteen hours before

Another plate (Fig 239), taken six hours later shows still further progress toward normal   Figure 240 taken November

Fig 240 —Forty hours after Fig 237   The heart is com ng back to its normal pos t on and the diaphragm can be seen

25th forty hours after onset shows the heart coming back to its normal position   There is still some density in the central portion and toward the base

By the end of seventy two hours the heart, by percussion, had returned to its normal position   There were a few crackling

râles at the angle of the left scapula; otherwise the physical signs were not abnormal

Temperature, pulse, and respiration showed slight upward excursions until the fifth day after onset of the collapse   Subsequently all were normal. The cough and production of sputum also diminished gradually and had disappeared by the fifth day.

Fig 241 —Fourteen days after onset of collapse

Figure 241 shows the condition of the chest two days before discharge, fourteen days after the onset of the collapse

Churchill in a recent discussion emphasizes the fact that the condition known as massive collapse is, in reality, but a special manifestation of pulmonary atelectasis   As such it is believed to result from the same etiologic factors as atelectasis occurring in other clinical entities   Of these etiologic factors, the two most

important are weakened respiratory force and bronchial obstruction.

Most cases of massive atelectasis occur following major abdominal operations. In most of these the respiratory excursion is shallow, due to pain, and there is an increased amount of secretion from the mucous membrane of the respiratory passages. The patient refrains from coughing in many cases on account of the pain incident to the strain on the wound, and bronchial secretion is apt to accumulate. Theoretically at least the combination of these factors could easily bring about atelectasis.

In the case reported it is interesting to note the prompt improvement which followed the raising of a quantity of thick tenacious sputum about six hours after onset. Conceivably with the raising of this sputum the occlusion of the bronchus was released, with partial re-expansion of the collapsed lung.

The onset of the symptoms may occur at any time following operation up to the seventh day. Most cases occur, however, during the first seventy-two hours. The duration is variable, but in most cases the condition clears up within a few days. The prognosis is invariably good in typical cases. It is, of course, possible that many postoperative pulmonary complications of longer duration and with less favorable prognosis have their origin in an area of atelectasis, undetected as such, which later becomes the seat of an infarction or an infection.

The symptoms and the physical signs noted in the case reported are typical. The outstanding physical sign is the marked displacement of the heart and mediastinal contents toward the affected side. This sign, together with the sudden onset of respiratory distress and physical signs suggestive of consolidation, should lead one to make a presumptive diagnosis of massive atelectasis. The x-ray is corroborative and portable plates should be taken as soon as the condition is suspected. The differential diagnosis is, of course, between an inflammatory process of the lung or pleura, or an infarction. Here again the marked displacement of the heart and mediastinal contents toward the affected side is the differentiating factor. A correct diagnosis is important both from the standpoint of prognosis and

in order to avoid misdirected diagnostic or therapeutic measures such as thoracentesis

There are no specific therapeutic measures in massive atelectasis beyond general supportive treatment and removal of any obstacle to free respiratory excursion   Binders should be loosened in order that the respiratory muscles may have full play   A high head rest facilitates breathing   Morphin should be given to control pain incident to the operation   After improvement has begun blow bottles are of use in promoting re-expansion of the lungs

DIVERTICULA OF THE ALIMENTARY TRACT

Sara M Jordan and Frank H Lahey

There occurs occasionally in all hollow viscera, alimentary tubes blood vessels gall and urinary bladders an abnormality which arises from a protrusion of all or part of the wall, and in the blood vessels is called aneurysm in the other organs is called a diverticulum Such 'preternatural pockets' were found at autopsy in the esophagus by Ludlow in 1764 and in the duodenum by Chomel in 1707 With the exception of rare surgical findings diagnosis of diverticula of the gastro-intestinal tract from pharynx to rectum was made only on the autopsy table until 1912 when x ray made it possible to identify and locate such abnormalities In the spirited discussions which have been conducted throughout many years as to the origin and development of these pockets three questions have received most attention

1 Are these diverticula true or false?

2 Are they congenital or acquired?

3 Are they pushed from within outward because of some inherent weakness in the muscular coat, or drawn from without through some inflammatory process external to the tube, in other words are they pulsion or traction diverticula?

The distinction between true and false diverticula was based upon the supposition that a pocket without a muscle coat was simply a protrusion of the mucosa through a hiatus in the muscle layer With more extensive studies of the histology of these diverticula it was noted that though the muscle layer was usually thinned out by distention of the sac, it always present immediately about the neck of the sac which in its origin, therefore, contained all layers of the normal intestinal wall

The matter of congenital or acquired origin became of interest when it was noted that most cases having symptoms referable to diverticula were of middle or advanced age Why

should a supposedly congenital deformity cause trouble only in
mature life? The answer to this question now practically unan
imous is that such a diverticulum represents a congenital weak
ness in the wall of the tube to which is added pressure from some
cause within resulting in the sac like projection of the wall
Another variety of diverticula was identified and distinguished
from this last type, namely, the so called traction diverticula,
produced by an inflammatory process which adheres to the
wall of the tube and draws out a small portion of that wall in
the form of a sac   A classification of diverticula into traction
and pulsion types was then made

It was at first thought that diverticula of the various parts
of the gastro intestinal tract were distinct entities but numerous
autopsy observations of multiple pockets in several parts of the
alimentary canal and even in the urinary bladder made it clear
that in some individuals there exists a tendency to diverticular
formation, which was then termed "la maladie diverticulaire '
or diverticulosis

Clinically the points of chief interest in diverticula are the
facts

1   That these pockets are rounded or oval structures attached
to and opening into the alimentary tube

2   That the contents of the gastro intestinal tract from the
stage of undigested food to that of feces may enter and be re
tained in such pockets

3   That symptoms may arise

(a) From pressure of a filled sac on the tube itself or upon
adjacent structures

(b) From retention of the contents of the sac with irritation
and inflammation

4   That except in the esophageal portion of the tube it is
difficult to ascribe symptoms solely to the presence of diverticula

5   That the logical treatment of such abnormalities is their
resection

6   That resection of the sac is often impossible because of its
location and that from the point of view of therapy, therefore,
the location of the sac is of prime importance

It is our intention to discuss the diverticula of the various divisions of the alimentary tube with reference to these clinical points of interest.

ESOPHAGEAL DIVERTICULA

Zenker and von Ziemssen were the first to classify diverticula of the esophagus into the traction and pulsion types. The traction type, funnel-shaped, with the apex directed outward

Fig 242 —Showing esophageal diverticulum of the traction type

and usually upward, rarely harbors accumulations, and therefore rarely causes symptoms Located, as they are, within the pleural cavity, they can be treated only by dilatation with bougies (Fig. 242).

The pulsion type, described accurately in 1764 by Ludlow and in 1816 by Bell, occurs at the pharyngeal dimple (Fig. 243)

on the posterior wall of the esophagus Presumably these pockets
are produced by a rise in intrapharyngeal pressure due to a
failure of the fibers of the inferior constrictor muscle to co
ordinate with the muscles above in the propulsion of the bolus
of food downward   The intrapharyngeal pressure results in a
protrusion of the mucous membrane through the pharyngeal
dimple (Fig 244) usually to the left of the esophagus, between
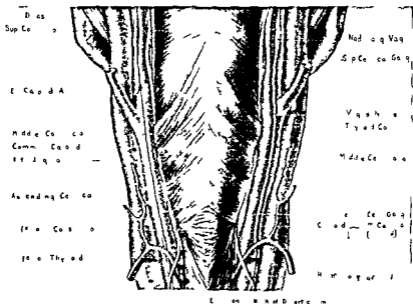the pretracheal and deep cervical fascia into the superior medi

Fig 243 —Drawing of dissection made under our direction to show
location of neck of diverticulum at the pharyngeal dimple the junction of
transverse and oblique fibers of the cricopharyngeus muscle

astinum when the diverticula become sufficiently large to reach
this point

The chief symptom of esophageal diverticula is dysphagia
which progresses from a slight discomfort in swallowing, with
dryness and scratchy sensation and expectoration of mucus, to
the real difficulties occasioned by the sticking of food par
ticles, at first large solid particles later small semisolid ones
Finally, even liquids are swallowed with difficulty   Pressure of

the filled sac and closure of the esophageal opening with its conversion into a slit like orifice are the causes of obstruction Regurgitation of undigested food without hydrochloric acid and foul breath usually attend this condition   Indirect results of

Fig 244 —x Ray of pharyngo esophageal diverticulum—pulsion type

pressure may be seen in the dyspnea cyanosis or hoarseness which occur in those patients who have large distended sacs

The treatment of pharyngo-esophageal diverticula consists

1 Of dilatation with esophageal bougies

2 Of surgical removal of the sac

Dilatation is frequently adequate in the earlier stages of diverticular formation but eventually surgery becomes imperative

The early history of the surgical treatment of pharyngo esophageal diverticula was very far from brilliant Suture of the esophagus following amputation of the sac was often followed by leakage which owing to the anatomic location of the sac beneath the deep cervical fascia found its way down into the mediastinum produced a deep cellulitis mediastinitis and eventually resulted in death in a high percentage of the cases Means to overcome this distressing complication were devised such as Bevan s inversion of the sac and freeing and fixation so that its apex was located higher than its opening into the esophagus thus preventing dilatation and accumulations within it These measures however were not satisfactory and it was not until the two stage removal of the sac was employed that surgery of the pharyngo-esophageal diverticula offered an outlook for the patient that was at all pleasant to contemplate In the two stage removal the first consists in freeing the sac implanting it upon the skin of the neck and then suturing the skin and muscles of the neck The second stage consists in removal of the sac after the wound is healed By means of this procedure we have operated upon six pharyngo esophageal diverticula all safely and with satisfactory outcome

The operation is readily accomplished under local anesthesia The upper pole of the thyroid gland is found and turned inward the external wall of the esophagus is then found presenting just behind the laryngeal cartilage The sac of the diverticulum which is usually located on the left with its neck opposite the level of the cricoid may be readily located and by gentle traction upward together with careful dissection may be elevated from its position in the mediastinum and freed from its loose surrounding attachments until it hangs by its neck at its point of origin The muscles and skin may then be caught to the neck of the sac by a few stitches and the skin wound closed about the neck the sac being left upon the neck in some boric ointment gauze At the end of ten days no anesthetic being neces

sary, the sac may be cut away, the mucosa snipped off from the canal as deeply as possible, and the resulting opening plugged with a little boric ointment gauze. The wound is then allowed to close, which it usually does in a week or ten days.

The simplicity and safety of this procedure is most gratify-ing. Following the placing of the sac in the dressings and the fixation of its neck to the skin, the patient is immediately able

Fig 245 —x-Ray of beginning recurrence of esophageal diverticulum in patient who had no postoperative dilatation

to swallow with the same freedom he enjoyed previous to the onset of his difficulty.

Writers upon this subject have laid little stress upon the factors leading to the production of pharyngo esophageal diverticula and still less upon the necessity for carrying out prophylactic measures against a possible return. From experi-ence with our first case, we wish to urge that postoperative dila-

tations of the esophagus be routinely employed for some time
following operation and that occasional bismuth x rays of the
esophagus be taken in order to be sure that the diverticulum is
not returning for it should be remembered that removal of the
sac of the diverticulum does not rid the individual of the factors
that produced it It is for this reason that we now advocate
repeated postoperative dilatations of the esophagus

Figure 245 shows the beginning return of a diverticulum in
our first patient who had had no postoperative dilatation
When returned for follow up he complained that he was again
beginning to have the early or prodromal symptoms of pharyngo-
esophageal diverticulum namely a scratching in his throat a
sensation of particles sticking there and hawking All of these
disappeared as soon as several metal olive bougies were passed
beyond the first portion of his esophagus

GASTRIC DIVERTICULA

The autopsy reports of pulsion diverticula of the stomach
are very rare Keith in 1910 reported 2 cases at the cardiac

F g 246 — x Ray of stomach with divert culum just below cardiac or fice

end of the stomach, apparently of the pulsion type, and a few cases have been reported in which pockets containing pancreatic cells were found at the cardiac and one at the pyloric end of the stomach   E S. Emery[1] reports 2 cases diagnosed by x-ray in which a diverticulum was found just below the cardiac orifice. Undoubtedly such cases will be found more and more

Fig 247 —x-Ray showing six hour residue in gastric diverticulum.

frequently as fluoroscopic technic is improved.   Figures 246 and 247 illustrate cases of gastric diverticula found by Dr L. B. Morrison, roentgenologist to the New England Deaconess and the New England Baptist Hospitals, in which the symptoms of substernal burning may well be due to the retention of gastric

contents and secretions in the pocket   The treatment of such
conditions should of course be surgical especially as the con
tinued irritation from retention in such pockets may justly be
considered a potential precursor of cancer

The fact however that pulsion diverticula of the stomach
have thus far been found near the cardiac orifice on the lesser
curvature makes surgical treatment impractical and usually
impossible because of the difficulty in mobilizing the stomach
and dissecting the sac

Occasional cases of so called traction diverticula of the
stomach have been observed in various areas of the stomach
Probably these are simply penetrating ulcers with perigastritis
in the inflammatory or the cicatricial stage

DIVERTICULA OF THE SMALL INTESTINE (EXCLUSIVE OF MECKEL S)

From the autopsy data the x ray data collected since 1912
together with the still scanty operative findings it would seem
that duodenal diverticula stand second in frequency to those
of the esophagus and are more frequent than those of the
stomach

Duodenal diverticula may be single or multiple   x Ray
findings as in Case s collection of diverticula [1] show an incidence
of about 6 per cent multiple pockets in the duodenum jejunum
and ileum but because of the fact that such lesions in the more
distal portions of the small intestine are exceedingly difficult
of demonstration the actual incidence of multiple diverticula is
probably much higher

The second portion of the duodenum is the part in which
pockets are most frequently found though they are occasionally
seen in the first part close to the pylorus as well as in the
third and fourth parts The size of the pocket varies greatly
from the size of a pea to that of an orange The presence of
the diverticulum frequently has no effect upon the caliber of
the adjacent intestine though this is occasionally constricted
from pressure or greatly dilated

The pathogenesis of duodenal diverticula, like that of those in other parts of the alimentary tract, is hypothetic The classification of traction and pulsion diverticula is made here as in those of the esophagus The traction pockets are produced by inflammatory processes in the neighboring organs, and as

Fig 248 —x Ray and diagram of x ray showing duodenal ulcer with diverticular process due to periduodenitis Pocket designated in diagram

such processes occur frequently in the organs adjoining the duodenum, the gall-bladder, pancreas, and liver, traction sacs are usually found on the first and upper part of the second portion associated with gall-bladder disease Penetrating ulcers frequently resemble such pockets, as in the case illustrated in
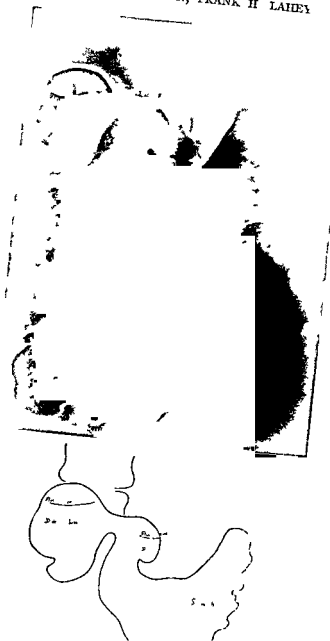
Fig 248   Pulsion diverticula are probably due to an inherent weakness in the intestinal wall and this plus the presence of some obstacle which has lodged in the duodenum or of stagnation of biliary and pancreatic juices produces a distention and finally a pocket   Occasionally the pathologic reports of such diverticula show the presence of pancreatic cells which would seem to indicate a congenital deformity causing no symptoms until distention from contents and pressure result or until stagnation and inflammation occur

The structure of the diverticulum is usually that of the normal intestine with or without serous coat according to its location   Where considerable distention has occurred the muscularis is thinned out and absent in places and if the sac is very large the mucosa is likewise thin   Depending upon the location of the pocket the adjacent structures are or are not involved in the pocket   Biliary and pancreatic drainage may be disturbed by the obstruction of the common or pancreatic ducts through their enclosure in the diverticulum   They have been found to empty into the diverticulum   With diverticulitis periduverticulitis and involvement of the pancreas hemorrhagic pancreatitis and fat necrosis may result

The diagnosis of duodenal diverticula is impossible clinically because the symptoms arising from inflammatory processes in the diverticula or from obstruction due to distention of the diverticula and pressure upon the adjacent duodenum biliary or pancreatic organs simulate those arising from similar processes in those organs themselves   Epigastric distress vomiting sub sternal pain heartburn constipation alternating with diarrhea loss of appetite and weight tarry stools and colicky pain in the right upper quadrant are seen in this condition and are frequently ascribed to other lesions of the right upper quadrant The severity of the symptoms depends upon the degree of distention in the sac which in turn causes pressure on the duodenum just as the esophageal diverticula press upon the esophagus and cause obstruction   One case seen in the clinic has periodic attacks of colic resembling gall stone colic induced by ingestion of coarse food   Raisins particularly cause severe pain

The x ray diagnosis of duodenal diverticula may be made
with little difficulty if certain points are observed in technic
With the patient lying on his right side the angle between
duodenum and jejunum is compressed and the barium held within
the duodenum so that all possible pockets may be filled out and
exposed Previous examination should be made, first, to make
certain that there are no other shadows present, such as those of
gall stones or calcified lymph nodes, second to make certain
the patency of the duodenum, as retention within the duodenum
from any cause obscures the picture and makes it impossible
to identify a diverticulum If no other shadows are present in
the preliminary examination and if barium passes normally
through the duodenum the diagnosis of diverticulum rests upon
a juxtaduodenal shadow which persists, which can be moved
by the palpating hand, and which is not tender to palpation
(unless as in an occasional case, peridiverticulitis is present)
Such a shadow persists for six hours to forty eight hours after
the meal as a definitely rounded shadow attached to but placed
to one side of the intestine Frequently, as in a case observed
in the clinic and illustrated in Fig 249, a fluid level may be
demonstrated It is always necessary to differentiate in x ray
diagnosis between an ulcer with a niche, a constriction of the
duodenum due to local spasm and dilatation of the ampulla of
Vater Repeated fluoroscopic examinations may be necessary
with the use of atropin to release spasm and confirm the diagnosis

With the diagnosis of duodenal diverticulum made by x ray
in a case suffering from gastro-intestinal symptoms otherwise
unexplained, the treatment is distinctly surgical In these cases,
as in the esophageal diverticulum, the location of the sac is the
important factor in the decision as to whether surgery is pos-
sible, but in the duodenal diverticulum this can be decided only
by exploration Dissection and resection of the sac are the
operative procedures necessary for cure but the crux of the
operation is the dissection If the sac is found to lie dorsal to the
head of the pancreas or to be involved in a mass of pancreatic
tissue with pancreatic and biliary ducts included in the mass,
dissection of the sac is exceedingly difficult and frequently im-

possible. When once the diverticulum is successfully freed from the adjacent structures, it should be resected. Invagination, as reported in a few cases, is much less satisfactory. Gastro-enterostomy is a desirable additional procedure, inasmuch as it gives temporary rest to the duodenum. Occasionally where a peridiverticulitis has been present, it becomes necessary to drain an abscess or to drain the gall-bladder or common duct. One case has been reported in which an ulcer and diverticulum were found in the same duodenum and the whole area was invaginated and a gastro-enterostomy done, but without permanent relief of symptoms.

The contents of the sac may be food, as in the case illustrated in Fig. 249, and operated in the clinic, where part of a motor meal given forty-eight hours before operation was recovered, or barium or chymous material, without recognizable food form, or, as in two reported cases, gall-stones.

The typical appearance of the sac on section is that of normal intestine, except in the most widely distended area, where muscularis and often mucosa is thinned out or lacking. There may be inflammatory changes, but in most cases these are not present.

If on exploration no surgery is possible, medical treatment in the form of non-irritating diet and care to maintain normal intestinal function are necessary, and, as in one case observed by us, where surgery has been refused, such treatment has been effective over a period of many years.

CHRONIC DIVERTICULA

In the past twelve years diverticula of the large bowel, which since Virchow's findings in 1853 were recognized by various observers from autopsy findings, and later recognized by Mayo and Moynihan surgically, have been demonstrated with increasing frequency by x-ray. Judd and Pollock report that one-third of the colons showing pathology have diverticulitis or diverticula.

These pouches may occur at any place from cecum to rectum, are usually single in other parts of the colon and multiple in the

sigmoid They are like diverticula of the rest of the alimentary
tract at first true diverticula with all coats of the intestinal wall
but with distention and inflammatory changes the muscularis
becomes thinned and disappears in places In the sigmoid they
are more prone to inflammatory changes than in any other part
of the alimentary tube and with such changes fibrous tissue
accumulates in the colon itself and in the surrounding tissue
Within the sac itself the muscle and mucous membrane coats
become thinned and rupture is more prone to occur than in
diverticula located elsewhere The resulting condition accord
ing to Judd and Pollock's statistics is never a general peritonitis
but always a localized abscess and this occurs in their series in
about 9 per cent of operated cases Another extradiverticular
condition recognized by Wilson is the periduverticulitis seen with
sigmoid diverticula with infiltration of mesenteric fat and
symptoms from peritoneal irritation resembling a left sided
appendicitis

The symptoms of colonic diverticula when inflammatory
changes occur and cause symptoms are pain tenderness and
constipation It is stated that about one-third of the cases have
a palpable tumor in which cases a differential diagnosis between
diverticulitis and carcinoma is difficult Diverticula with and
without chronic inflammatory changes occur without symp
toms and in this group of diverticula as in the gastric and upper
intestinal group it is sometimes difficult to associate definitely
and accurately the presence of the abnormality with symptoms
of pathology Obstruction as a sign of diverticulum occurs
usually only in the presence of inflammatory changes which
produce a mass which in turn causes pressure upon or angula
tion of the intestine The pockets themselves in the colon are
usually of such small size that even when filled with fecal material
they are not obstructive Examples of such pockets are seen in
the case illustrated in Fig 250

The diagnosis of colonic diverticula by x ray is less constant
than in diverticula of the upper gastro-intestinal tract The
contents of the colon being of firmer consistency than those of
the stomach and small intestine may easily fill the pockets so

tightly that no barium enters   When inflammatory changes have occurred, a spastic sigmoid with a thickened wall and possible obstruction point toward diverticulitis   Diverticula diagnosed by x-ray should be differentiated from kinked areas of intestine filled with barium, ureteral or bladder calculi, or calcified mesenteric lymph nodes

Fig 250 —Showing diverticula of sigmoid in a case of diverticulitis

Diverticula of the colon, because they are in themselves non-obstructive, need no treatment   When inflammatory changes have occurred and are sufficiently severe to cause pain, tenderness, constipation, or obstruction, it becomes necessary to decide between medical management and surgery. If a palpable mass is present, even without blood in the stools, it is almost necessary to explore unless there has been a long-standing history of

similar symptoms with remissions in which case it is fair to assume that the condition is diverticulitis Even with explora tion it is sometimes impossible to determine without a histologic examination whether the condition is simple diverticulitis or carcinoma The ideal surgical procedure is resection but unfor tunately since this procedure must be executed in the presence of infected bowel wall its mortality is exceedingly high Pallia tive surgery consists in colostomy but this in no way causes the existing diverticula to disappear but allows the inflammatory process to subside only as long as the fecal current is diverted and the same possibilities of complications persist if the fecal stream be restored to its normal course The actual surgery of diverticulitis therefore consists largely in palliative meas ures such as drainage of perisigmoid abscesses colostomy for obstruction resection when the suspicion of malignancy is sufficiently grave or when the localization of the process makes the prognosis seem sufficiently favorable Occasionally also recto vesical sinuses due to rupture of infected diverticula into the bladder require repair Even in this relatively minor con dition recurrence however is not uncommon It is evident therefore that the surgical treatment of diverticulitis of the colon is by no means entirely satisfactory and consists largely of dealing with problems secondary to this condition as they arise Medical management is frequently adequate in that normal bowel function and relief of colonic spasm empty the pockets remove the irritating cause of the inflammatory proc ess which then frequently subsides The recent treatment with barium enemata though apparently successful in some cases appears illogical from the point of view of etiology of the condi tion in that a pocket already partly filled with feces if still further occluded with barium holds the original source of irrita tion even longer than usual Only pockets which were by chance empty before injection of the barium are protected from the irritation of feces

It is now believed that diverticulitis is not at all a precursor of carcinoma

CONCLUSIONS

From a consideration of diverticula of the various parts of the alimentary tube it may be concluded that the symptoms of diverticula arise from the same causes in all parts of the tube, namely, from retention of tube contents and pressure of the filled sac or from inflammation Symptoms from pressure of the uninflamed sac occur more frequently in the esophagus and with decreasing frequency in the lower parts of the alimentary tube Inflammatory changes occur with greatest frequency in the lowest end of the gastro intestinal tract because of the irritation of the dehydrated contents The only cure of diverticula is resection, but in all parts of the gastro intestinal tract this is frequently impractical because of the inaccessible site of the sac Medical treatment consists chiefly in the establishment or maintenance of normal function of the gastro intestinal tract in order that the pockets may be kept empty or in the dilatation of strictures caused by pressure in the part accessible to such treatment

END-RESULTS—CLINICAL, CHEMICAL, AND MECHAN-ICAL—IN TWELVE PYLORECTOMIES

Sara M. Jordan

In the treatment of gastric and duodenal ulcers the choice of medical or surgical treatment is the first consideration. Where there are no definite surgical indications, such as (1) the acute condition due to perforation, or (2) an unrelievable obstruction, or (3) a reasonable ground for suspicion of carcinoma, medical management should, in our opinion, be used first. In those cases where *medical management fails, and this occurs in certain* chronic ulcerations where a bleeding vessel protrudes from the center of a callous area, and in those cases which, when first diagnosed, have distinctly surgical indications, there arises at once the consideration of a choice between conservative and radical gastric surgery. The position of conservative surgery, gastro-enterostomy with or without excision of ulcer, according to recent reports in the literature, is at least uncertain at the present. The frequency of jejunal, gastrojejunal, and recurrent duodenal ulcers has tended to make doubtful the position of this more conservative form of surgery. Better functional results follow the more radical forms of pyloric and gastric resection. Of course in those cases in which there is a suspicion of carcinoma or where conservative measures in the form of medical management have been adequately tried and failed, the definite surgical risk may be fairly undertaken.

To the removal of the acid generating part of the stomach is ascribed the reason for better functional results. In other words, it is believed that with the partial or complete surgical removal of the corrosive factor in ulcer formation, new ulcer formation is prevented. Stein and Fried in 1923 reported observations which showed that anacidity and hypochylia, the usual result

of extensive stomach resections were gradually produced with
a slower decrease in the ferment content than in the acid
Directly after operation there was a tremendous secretion of
gastric juice probably due to stimulation from the cut secretory
fibers. The fasting contents showed a much higher acidity
than those obtained after a test breakfast a fact which was
explained by these investigators as due to the increased stimula
tion caused by the injured centripetal nerves as contrasted with
a lack of stimulation from the contact of food with the mucous
membrane of the antrum After two months subsequent to the
operation the secretion after the test meal contains more free
acid than that of the fasting contents

Ivy and Yutaka Oyama showed in 1921 that Beasley s
conclusion that the secretion of the pyloric gland is purely
mucous and contains no specific digestive substance is correct
The removal of the antrum of the stomach is therefore neces
sary to produce a depression of the digestive secretions desirable
because of the presence in them of acid with its corrosive action
The untoward concomitant symptoms of unexplained functional
anacidity gas distress and diarrhea have not been observed
by us in postoperative cases with anacidity Stein and Fried
carried on certain investigations to demonstrate that with the
surgical depression of hydrochloric acid there is a compensatory
pancreatic hyperchylia

It is therefore probable that the chemical loss resultant
upon subtotal gastrectomy however extensive this may be is
desirable from the point of view of prevention of ulcer recurrence
and probably because of pancreatic compensation is not detri
mental to digestion

What is the effect of resection on the mechanical function of
the stomach? That normal tonus and peristalsis are extremely
important factors in gastric comfort is a well known fact Hyper
motility and excessive tonus are the familiar cause of distress
especially in the ulcer picture The opposite defect namely
gastric atony and a failure of the stomach or remnant of stomach
to hold and to peristalt its contents are too infrequently con
sidered as of importance in a failure to secure postoperative

comfort   In our observation a portion of stomach, however small it may be, which whether because of its unimpaired or restored innervation or for some other reason, holds for a time the material which enters it by the muscular tonus of its walls and moves it along at a normal rate, and with rhythm gives to its possessor a sense of gastric comfort and well being comparable to that secured by the function of the normal stomach.

Fig 251—Showing pylorectomy case one year after operation   Good function   Normal tonus   Emptying in three hours

On the other hand, the remnant of the stomach, which looks and, what is more important, acts like a funnel or sand screen, empties rapidly into the jejunum and causes discomfort which may be a mild sense of fulness after food taking or may be so severe as to cause nausea, vomiting, emaciation, and chronic invalidism.

It should be the aim of surgery in both the obviously malignant as well as the benign lesions to obtain mechanical efficiency

of the remaining portion of the stomach as well as the safe removal of the pathologic part and the prevention of ulcer recurrence by surgical depression of acid

The method for accomplishing this end will be clear only with the aid of continued study on the part of the surgeon clinician, and laboratory workers

Fig 252 —Pylorectomy case three years after operation   Muscle tonus of stomach wall poor   Function poor   Rapid emptying into jejunum   Clinical condition poor   Ten months after this observation this patient was found to have recurrent carcinoma at the stoma

The table on p 771 demonstrates briefly the clinical, chemical, and mechanical results in twelve pylorectomies done in this clinic, which were available for follow up observations

Unfortunately only Cases I II and III had preoperative gastric analyses which were as follows

Case   I—28–44

Case   II—10 24

Case III— 0 9

TABLE SHOWING END RESULTS—CLINICAL CHEMICAL AND MECHANICAL—IN TWELVE PYLORECTOMIES

Case number	Type of operation	Year of operation	Diagnosis	Symptoms 1925	Free and total acidity 1925	Mechanical function observed fluoroscopically
1 A T	Polya type of pylorectomy	November, 1924	Carcinoma of antrum	None	0 20	Tonus good Peristalsis normal Emp tying time two hours
2 H R	Polya type of pylorectomy	June, 1924	Lymphoid hyperplasia tonus with ulceration	None	0 6	Tonus good Peristalsis normal Emptying time three hours
3 W G	Polya type of pylorectomy	August 1924	Chronic ulcer	None	0 4	normal Emp
4 I R	Polya type of pylorectomy	January 1923	Chronic ulcer	None	6-18	normal Emp
5 A A	Billroth No 2 pylorectomy	1922	Chronic ulcer	None	21 35	normal Emp and one half
6 F C	Polya type of pylorectomy	1923	Chronic ulcer	None	51-65	normal Emp
7 P M	Polya type of pylorectomy	1922	Chronic ulcer	None	29 46	normal Emp
8 B A	Polya type of pylorectomy	1922	Chronic ulcer	Slight gas distress after food taking	22 38	barely visible ur
9 B L	Polya type of pylorectomy	1921	Carcinoma of antrum	Gas distress after food taking relieved by bowel management	0-12	normal Emp Fluoroscopy tion and atony
10 M R	Polya type of pylorectomy	1923	Carcinoma of antrum	Severe nausea and vomiting until distress after food taking, loss of weight	No contents recovered thirty minutes after test-meal	status not yet [test] military activities observation and ectomy patient current proper stoma
11 D H	Billroth No 2 pylorectomy	1923	Chronic ulcer	Less listless after food	0 3	brately visible
12 B P	Polya type of pylorectomy	1922	Chronic ulcer	Ulcer distress due to recurrent gastric ulcer 1925 relieved by medical management	21-10	normal Emp

Fig. 253—Pylorectomy case three years after operation, showing acute recurrent ulcer at the stoma

Fig 254—Same case after medical treatment of ulcer   Stoma smooth.

The striking fact in the follow-up observations of this small series is that though the chemical findings vary from an anacidity in 4 cases and a subacidity (free HCl-6) in one case to normal acidity (free HCl-21 to 29) in 3 cases, and a free HCl of 51 in 1 case, the presence or absence of acid apparently bears no relation to the clinical condition, whereas the mechanical function, as observed fluoroscopically, was normal in 7 out of the 8 cases who had no symptoms (Cases I to VII and IX). Emptying time in these 7 cases was two to three hours. Case IV had no fluoroscopic examination. In Cases VIII, X, and XI, who had symptoms, the mechanical function was observed to be poor and the emptying time one hour or less. Case X was the only case suffering from severe symptoms with resultant malnutrition. Her mechanical function was poorest, and ten months after this follow-up examination this patient was found to have an inoperable carcinoma at the stoma. Case XII showed recurrent ulcer at the stoma which disappeared clinically and by radiologic examinations under medical management.

Numerous observations made after gastro-enterostomy also show the importance of the maintenance of tonus and peristalsis as the chief factor in postoperative comfort. Anacidity is rarely produced in our experience by gastro-enterostomy, and the presence or absence of acid, however important it may be in the question of incidence of gastrojejunal ulcer, bears apparently no relation to postoperative comfort. Here again, however, the preservation of gastric tonus and peristalsis are coincident with a lack of distress, whereas the dumping type of stomach with rapid filling of the jejunal loops is a source of constant distress to its possessor.

CONCLUSIONS

The tendency in recent treatment of gastric and duodenal ulcers seems to be both more conservative and more radical, more conservative, in that medical management in a well-regulated and adequate form is used as long as it is fair—more radical in that when surgery is used, the conservative form of gastro-enterostomy tends to be supplanted by radical resection of the acid and ulcer-bearing area of the stomach. It is, there-

fore opportune to consider end results of both methods of treatment and to direct our efforts toward securing postoperative comfort in the more ra lical form of treatment, when it is em ployed

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SUBPHRENIC INFECTION AFTER APPENDICITIS

Howard M. Clute

THE patient before us is a young man of twenty two He
was born with deformities of all of his limbs which have neces
sitated a long series of orthopedic operations As a result of
these procedures he has been able to get about on crutches and
to do many things for himself with his hands and arms Aside
from these deformities and the illnesses accompanying their
operative repair he has had nothing remarkable in his past
medical history

Forty eight hours before entrance to the hospital this boy
was taken with a severe pain in the central portion of his ab
domen The pain gradually became localized in the lower right
quadrant He vomited Castor oil was given him at home, which
caused a bowel movement, but gave no relief from his pain He
therefore took some other cathartic Because this also failed
to relieve the pain and because he was still vomiting he was
brought to the hospital on February 11, 1926

The notable findings on physical examination were the ab
dominal distention and generalized muscle spasm Tenderness
was present everywhere across the lower third of the abdomen,
but was more pronounced on the right side Rectal examination
revealed tenderness, but no swelling His chest showed no
evidence of pathology His urine showed the slightest trace of
albumin 3 to 6 white blood cells and a rare red blood cell in
each high power field His white blood count on admission was
26 450 His temperature was 101 2° F, his pulse 120 and
respirations 26

A preoperative diagnosis of perforating appendicitis with
beginning peritonitis was made, and he was taken at once to the

operating room At operation it was found that the appendix lay to the outer side of the cecum and was gangrenous in its proximal portion There was a perforation just at the junction of the cecum and appendix from which fecal matter was exuding The incision was enlarged anesthesia deepened to secure adequate muscular relaxation and the infected area very carefully walled off with wet gauze strips Under direct vision the appendix was readily removed and cigarette drainage inserted to the point at which it had rested The omentum was gently tucked in around the drain and the cecum The abdomen was closed in layers about the cigarette drain

After operation the condition of the patient improved He was elevated on a head rest and in addition the head of the bed was also raised on blocks Because of the patient s many deformities and his inability to flex his thighs it was rather difficult to keep him in a high Fowler position For the first forty eight hours he was given absolutely nothing by mouth Morphin was administered in sufficient quantities to keep him completely quiet Tap water was given by rectum every four hours and an intravenous injection of 500 c c of a 10 per cent solution of glucose was given twice daily After forty eight hours of this regime water was given by mouth and was soon followed by other liquids and soft solids

In four or five days it became apparent that the danger of peritonitis and death in this case was passing The abdomen became soft, gas was passed readily by rectum and food and fluids were well retained His general appearance improved very markedly The fever which was present before operation however did not disappear As the days grew in number and as his condition improved otherwise it was expected that his temperature would come to normal Instead however, it remained constantly elevated at a level between 101° and 10 ° There were no subjective symptoms offering a clue possible cause of the persistent fever

It has been our experience that persisting fever laparotomy is almost always due to one of three causation in (1) the wound (2) the pouch of Douglas or

etiology for a subphrenic abscess was present   (2) No focus of
infection either in the wound or the pouch of Douglas could be
found   (3) The patient had no symptoms save persisting fever
and rapidly increasing weakness

Fig 255 ~This x ray shows density in the right chest except at the
apex with evidences of fluid or thickened pleura at the base The heart is
pushed to the left Chest tap after this picture gave only clear serous flu d
This illustration has been reversed in reproduction

A portable x ray of the chest was taken on February 23d by
Dr L B Morrison who reported as follows (Fig 255)   The
right chest is completely dense except the very apex   The
diaphragm is not seen   The heart is pushed somewhat to
the left   The left chest is otherwise normal   We should

judge there was fluid in the right chest with thickened pleura."

The chest was tapped, and clear serous non infected fluid was withdrawn. A needle was then inserted in the tenth inter space in the right midaxillary line and pushed inward beneath

Fig. 256 —Plate taken after withdrawal of much serous fluid from the chest. Heart is still pushed to the left. Level of diaphragm on the right is not apparent. It was probable however that pus was present beneath the diaphragm in view of the fever and the sterile fluid in the chest

the diaphragm in an attempt to find pus above the liver. None could be found. It was our opinion however that the pus was in that location. It is almost always true that a simple serous pleurisy will be present in the chest when there is pus just be neath the diaphragm. The amount will vary from a few to

several hundred cubic centimeters Since this patient now had serous fluid in his right chest which had been clear before his operation we inferred that it was in some way related to his present difficulties though obviously the chest fluid was not the cause of the fever It seemed increasingly evident that there was pus beneath the diaphragm and above the liver on the right side if we could but find it

After an interval of eight days the patient s fever was still high and his general condition seemed distinctly poorer A further search for the subphrenic pus was undertaken His chest was again aspirated and all the fluid possible was removed The needle was again inserted at a lower level beneath the diaphragm into the subphrenic space Clear serous fluid came from the pleural cavity Nothing was found beneath the diaphragm An *x* ray after this procedure showed the right chest about half filled with fluid No air noted under the diaphragm on this side The heart is slightly pushed to the left

Two days later another puncture was made in the posterior axillary line in the tenth right space into the subphrenic space Much foul smelling pus was obtained and the long search for the cause of the fever was rewarded On the same day March 8th almost a month after the appendectomy the patient was again taken to the operating room and under local anesthesia the first stage of the operation which we prefer for draining a sub phrenic abscess was performed Two inches of the tenth rib were removed in the posterior axillary line at the site of the puncture which had returned pus The pleural cavity was opened and the parietal layer of pleura was sutured to the diaphragm with a running stitch This is readily performed because the abscess beneath the diaphragm pushes it up to an abnormally high level and thus brings its lateral portion in relation with the lateral wall of the chest The running suture may fully wall off the pleural cavity *but we prefer to pack the* wound and wait for forty eight hours until fairly firm adhesions have formed before we open the abscess Failure to observe this precaution may result in empyema After two days there fore we performed the second stage of the operation The

patient was given ethylene and oxygen anesthesia and the pack removed from the incision The fibers of the diaphragm were now incised and retracted Just beneath them could be seen the liver A finger gently inserted encountered dense adhesions posteriorly between the liver and the diaphragm These were

Fig. 257 —Later view of the right diaphragm of was a large rubber tube which has been inserted to drain the subphrenic abscess The tube lies just beneath the diaphragm and above the liver These incisedly all issued of the diaphragm are now rapidly receding

gently freed, a big abscess cavity was entered, and a large quantity of foul smelling pus evacuated A cigarette drain and a rubber tube were inserted and a few skin sutures put in place

It is now eight days since the abscess was drained But little pus comes from the wound and the drains are being replaced with rubber tissue The temperature has gone to a lower height

each day and today has been scarcely above normal   The
patient s general appearance and sense of well being are rapidly
improving   Recovery now seems assured

A recent lateral x ray of the chest (Fig 257) shows the right
diaphragm is still much higher than normal   The drainage tube
can be seen just beneath it   The evidences of pathology above
the diaphragm are rapidly disappearing in the x ray picture

CONGENITAL DEFECTS OF THE KIDNEY

Howard M. Clute

DEVELOPMENTAL disturbances of the kidneys and ureters are classified as defects in (1) number, (2) form, and (3) position. The following 4 case histories give examples of each of these possible difficulties.

The developmental changes bringing about the normal adult position and function of the kidneys and ureters are extremely complex and are completely interwoven with the development of the reproductive organs. As would be expected, therefore, congenital defects of the kidneys or ureters are not infrequently associated with defective development of the internal or external reproductive organs. At about the fourth week of embryonic life a bud appears near the cloaca on each Wolffian duct from which develops the ureter, kidney pelvis, and later the kidney. This original point from which the urinary apparatus grows is situated in the true pelvis at about the level of the second sacral vertebra. At this level the kidneys slowly develop and also gradually migrate upward to their normal adult position. During this migration from the pelvis there occurs an axial rotation of the kidney. The pelvis, which in the original position of the kidney is ventral, gradually rotates inward to assume its mesial direction. The blood supply of the kidneys does not become finally established until the kidney has reached its permanent position. During its early growth and migration the vascular supply of the kidney is by means of numerous capillary vessels. When the kidneys are finally placed in the loins suitable capillaries enlarge and become the renal vessels. All the abnormalities of number, form, and position of the kidneys can be readily explained and understood with a knowledge of the factors involved in the development of the urinary tract.

Case I—B K, a woman aged twenty-four, came first to the clinic in November, 1924 because of pain in the left back radiating down the left loin She had never had any previous illness of note and had always considered herself healthy

For the past four or five months this woman had had nearly constant backache During the past four days the pain has been very severe General examination was negative save for tenderness over the left kidney The urine was normal Wassermann negative NPN normal Phenolphthalein excretion normal Cystoscopy showed a good function and normal urine on the
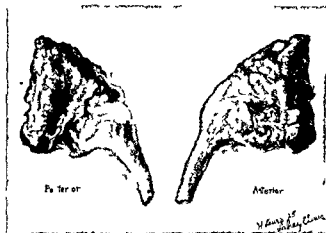
Fig 738—Case I Drawing of specimen of rudimentary kidney removed in Case I Note normal appearance of pelvis and ureter Mal development largely limited to structures of the cortex

right On the left side was diminished function but clear urine Pyelo ureterograms showed an infantile kidney on the left with a very narrow strictured ureter and a normal kidney on the right It was found that the passage of ureteral catheters relieved the left kidney pain and an attempt was made to carry this patient along with occasional ureteral dilatation For a time this succeeded, but in June 1925 dilatation was found to be insufficient and the infantile kidney was therefore, removed Recovery since operation has been uneventful

Congenital absence of one kidney is very rare From a

careful survey of many autopsy records Morris states that this
abnormality occurs about once in 2500 cases. In some cases no
vestige of the absent kidney is found. In other cases, as in the
present instance, development has gone on to a certain degree
and then ceased. This type of kidney is termed by some writers
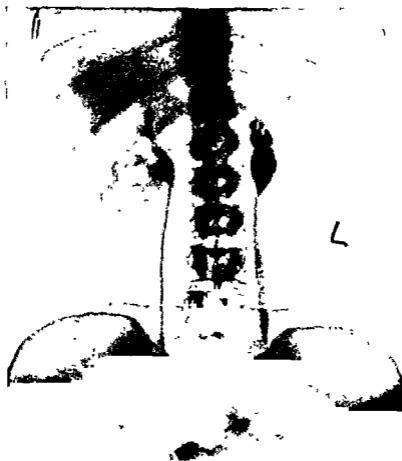a "congenitally atrophic kidney."

Fig 259 —Case I. Bilateral pyelogram showing rudimentary kidney on the left and normal kidney on the right.

Rudimentary kidneys may be found in any stage of develop-
ment and of function. In the present case clear watery urine
was secreted, as well as a small amount of phenolsulphoneph-
thalein. Pyelo-ureterograms were made showing the contour
present (Fig. 259).

The reason for the repeated attacks of left renal colic with frequent and painful urination which this girl suffered is not clear. There was never any evidence of infection in either the urine examinations or the cystoscopic picture. No further pain has occurred since the operation.

Case II.—Mr F. C F., a man aged forty-two, came to the clinic August 12, 1925 because of pain in the left lower quadrant.

Fig. 260.—Case II Plain x-ray plate of abdomen showing outline of horse-shoe kidney.

In the course of his examination cystoscopy was done and pyelograms were made which revealed a horseshoe kidney at the level of the second lumbar vertebra The pelvis on each side

was normal, as was the ureter   The urine from each side was normal   The pain in the left abdomen was found to be due to *enlarged mesenteric nodes and not related to the horseshoe kidney*   No operation was necessary and all symptoms have now disappeared

Horseshoe kidneys are not uncommon   They occur, on an average, once in 1100 people, and are examples of maldevelop-

Fig 261 —Case II   Bilateral pyelogram in case of horseshoe kidney   No pathology other than fusion of the cortex is noted, each pelvis being normal.

ment in the form of the kidneys   Horseshoe kidney is the result of a fusion of the lower poles of the kidneys before the third month of intra-uterine life   The resulting deformity of the kidneys depends on the degree of fusion, the limitation of the ascent of the kidneys by the deformity, and the absence of axial

rotation of the kidneys. The bridge of tissue connecting the two kidneys may be fibrous tissue or good renal tissue.

The two pelves of the horseshoe kidney illustrated here show no fusion, and we may infer that the cortical fusion occurred after the pelves were fully developed.

Horseshoe kidneys may cause no difficulty throughout the patient's life. Symptoms may appear, however, from the same causes that act in normally shaped kidneys, such as stones, ob-
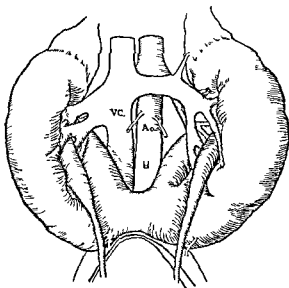

Fig 262 —Case II Schematic drawing of horseshoe kidney (Adapted from drawing in Kelly and Burnham's Diseases of the Kidneys, Ureters, and Bladder)

structions to the ureter, infections, and new growths In the case presented here we were unable to find any abnormality in the horseshoe kidney or any symptoms referable to it.

Case III.—C. W , a single woman, aged twenty-seven, came to the Clinic August 11, 1925 complaining of attacks of pain in the left side and back with fever and vomiting.

Three years ago this patient had been operated upon in another city At that time an incision was made over her right

kidney region   No kidney was found. A second incision was
made over the gall-bladder, and further search revealed no evi-
dence of a kidney on the right. The gall-bladder was drained
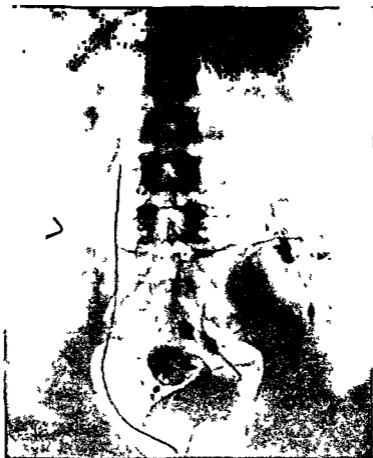and the appendix removed

Fig 263—Case III   Large stone in pelvis of left kidney   Pyelogram
of pelvic kidney on the right   Note the calices above the bladder which is
partly filled with sodium iodid   The remains of a barium enema are still
visible in the rectum

During the past three years since this operation the patient
has had repeated attacks of severe pain in the left flank. These
were accompanied by severe constipation and disappeared with
repeated enemata   The present attack was more severe than
any she had previously experienced   There was no painful or
frequent urination   Examination showed a thin, pale woman.

General examination was negative save for tenderness over the
left costovertebral angle with heavy (fist) percussion The urine
showed a slight trace of albumin and much pus, with rare red
cells The NPN was 30 mgm per 100 c c. The total phenol-
phthalein excretion at the end of two hours was 48 per cent.
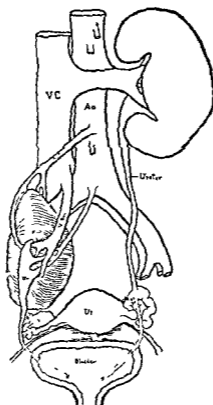x-Rays of the gastro-intestinal tract revealed no lesion associated

Fig 264 —Case III Schematic drawing of pelvic kidney (Adapted from
Kelly and Burnham s Diseases of the Kidneys, Ureters, and Bladder)

with the bowel x-Rays of the urinary tract showed a stone in
the left kidney pelvis which was nearly a complete cast of the
pelvis No kidney outline could be seen on the right Cystos
copy showed a bladder not abnormal in appearance The left
ureteral orifice was gaping and somewhat red On the right side
a normal ureteral orifice was found After catheterization urine

was obtained from each ureter On the right it was clear and on the left it showed pus and blood The phenolphthalein test appeared in four minutes on the left side and five minutes on the right, and was of excellent color on each side   x Rays showed the catheter in the left ureter in relation to the stone in the left pelvis A pyelogram on the right side showed a pelvic kidney smaller in size than normal In this ureter near the pelvis was a stone

At operation the large cast of the left kidney was removed through an incision in the pelvis extending upward into the cortex of the kidney Recovery from this operation has been complete

Case IV—E T, a woman married, aged forty seven came first to the Clinic August 31, 1925 complaining of painful micturition She had never been ill since childhood and had never been pregnant She stated that four weeks ago she had had fever chills and frequency of urination At this time she also had some tenderness over her left kidney region Her urine showed pus She has had occasional attacks of fever during the past month

Examination showed nothing remarkable, save for some tenderness in the left loin The urine showed pus cells and an output of 38 per cent phenolphthalein The NPN was normal Cystoscopy showed nothing remarkable in the bladder The left ureteral orifice was somewhat edematous The right ureter appeared normal A catheter passed readily to the left kidney, but no catheter could be passed more than 2 inches on the right side Urine from the left kidney showed a few pus-cells per field No urine came from the right side Pyelograms were made On the left side was found a kink of the ureter at the ureteropelvic junction with early blunting of the calices and dilatation of the kidney pelvis On the right side, after several attempts and the use of considerable pressure the injecting fluid ran in but a short distance to a dilated area that was apparently the pelvis of a pelvic kidney No kidney outline could be seen in the right flank and it was our opinion that this patient

had a pelvic kidney on the right which had little if any *function*. The left kidney was exposed through the lumbar route, and *aberrant vessels distorting the ureter* were removed and the kidney was suspended. Recovery was uneventful.
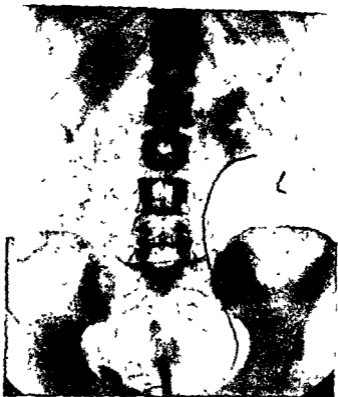

Fig 265 —Case IV Pyelogram of right kidney showing it to be rudimentary and still present in the pelvis Repeated plates show no evidence of any lumbar kidney on the right The left kidney was normally located

Defective kidney development resulting in abnormal position of the kidney is not often seen. These 2 cases are excellent examples of this condition A kidney may be in an abnormal position as a result of an unusually loose attachment to its surrounding structures or as a result of the presence of pathology in the kidney or in a neighboring viscus acting upon it We have seen a simple serous cyst in the lower pole of an otherwise

normal kidney pull the kidney well down to the brim of the true pelvis In these cases, however, the ureter is of normal length and extends over a markedly distorted, tortuous course When the kidney fails to rise to its normal position in embryonic life, the ureter is generally entirely pelvic and much shorter than in the normal kidney In pelvic kidneys variations in form or number as well as in position may be present The pelvic kidney, however, may be normal in every respect save its position

Abnormalities of the generative organs are said to accompany all three types of developmental kidney defects In these 4 cases no such abnormality is obvious, although in 2 of the cases only superficial examination has been made In one of the patients having a pelvic kidney an infantile type of uterus is present and the patient has never been pregnant through many years of married life

Pelvic kidneys have considerable clinical importance This possibility must be considered when any retroperitoneal tumor is found in the pelvis The presence of a pelvic kidney may cause marked difficulty in labor Stones, ureteral obstructions, infections and tumors may also occur in pelvic kidneys These may give rise to unusual symptoms because of the abnormal position of the kidney In Case III however a stone in the ureter or pelvis of the kidney has apparently caused no symptoms